

# **FAIRFAX COUNTY AIR QUALITY MONITORING ANNUAL SUMMARY 1998**

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**Environmental Monitoring and Trends Analysis  
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## **F O R E W O R D**

This is a technical report summarizing the data collected by the Environmental Monitoring and Trends Analysis staff from the air quality monitoring network in Fairfax County during the calendar year 1998. The report design is intended to meet the needs of concerned County citizens and organizations and public and private administrators whose decisions must reflect air quality considerations. Air quality summary reports have been issued annually since 1973. Persons requiring additional technical information should contact Environmental Monitoring and Trends Analysis staff to see if more detailed information is available.

# AMBIENT AIR QUALITY AND METEOROLOGY

## A. OVERVIEW

Environmental Monitoring and Trends Analysis is authorized by the Fairfax County Code, Chapter 103, in cooperation with Federal and State agencies, to conduct an air monitoring program. The primary purpose of the air monitoring program is to measure the levels of air quality to ensure the protection of human health, welfare and safety, and to the greatest degree feasible, prevent injury to plant and animal life and property. The ambient air monitoring stations are sited in such a manner as to indicate residential, health based pollution concentrations. The objective of this monitoring network is to track ambient air pollutant levels to indicate compliance or non-compliance with Federal standards, to observe effects on pollutant levels from regulatory controls on sources, to develop data for trend analysis, and to provide data for the air quality index and forecasts.

The air quality monitoring program consists of monitoring for the Environmental Protection Agency (EPA) criteria pollutants, ozone (O<sub>3</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), lead (Pb), and particulate matter (PM<sub>10</sub>). In addition, other non-criteria pollutants, total suspended particulates (TSP), nitric oxide (NO), and meteorological parameters; wind direction, wind speed, temperature, and rainfall are monitored.<sup>1</sup>

The pollutant monitoring network maintained and operated by Fairfax County Health Department Environmental Monitoring and Trends Analysis staff consists of the following:

- 4 Continuous monitoring stations for gaseous pollutants
- 4 High volume particulate/lead samplers
- 5 Fractional particulate samplers of 10 micrometers (PM<sub>10</sub>)
- 1 Acid deposition station
- 5 Meteorological stations

The data are reduced to both monthly and annual terms and are shown in both tabular and graphical forms to reveal seasonal and short-term changes that would be obscured by longer term averaging. Comparisons with applicable standards are emphasized. The Ambient Air Quality Report is supplemented with three appendices. Appendix A contains graphical representations of monthly trend data for 1998. Appendix B contains a trend analysis and a set of graphs showing multi-year trends for several air pollutants and several independent factors. And Appendix C provides the location and description of the monitoring stations.

<sup>1</sup> Additional monitoring for special purpose and special impact studies are done. The results of these studies are published separately and are not reflected in this report.

Data reduction is done in-house, and the data are placed in a computer database for use in assessing current air quality, identifying air quality trends, and analyzing periods of elevated concentrations. Pollutant data are sent to the United States Environmental Protection Agency (EPA) for incorporation into the Aerometric Information Retrieval System (AIRS) database, and the Virginia Department of Environmental Quality (VDEQ).

The National Ambient Air Quality Standards (NAAQS), as defined in Title 40 of the Code of Federal Regulations Part 50, which are based on human health and welfare considerations, provide a basis for evaluating air quality in Fairfax County. The primary standards define the levels of air quality necessary to protect the public health with an adequate margin of safety. The secondary standards define levels of air quality necessary to prevent any degradation or harm to the total environment.

For this report, gaseous pollutant concentrations are expressed in parts per million (ppm); particulate matter and lead concentrations are expressed in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ).

## **B. QUALITY ASSURANCE PROGRAM**

The Air Quality Monitoring Branch maintains a quality assurance/control program based on requirements stated in Title 40 of the Code of Federal Regulations, Part 58, Appendix A. The County quality assurance (QA) program is used to assure that the monitoring data is of the highest quality and to minimize the loss of data due to instrument malfunctions or out of range operating conditions. A database of the precision, accuracy and audit results are maintained on a microcomputer using software developed by EPA, and are submitted on a quarterly basis to the EPA and VDEQ. The Air Quality Monitoring Branch also participates in the EPA National Performance Audit program and the annual Ambient Air Monitoring Systems Audit program.

## C. CRITERIA POLLUTANTS

### 1. Ozone (O<sub>3</sub>)

Ozone is not emitted directly from pollution sources (i.e. smokestacks, tailpipes), but is formed by a complex series of reactions among nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOCs) under the influence of solar ultraviolet radiation (sunlight). Two significant sources are the incomplete combustion of gasoline from motor vehicles and other volatile organic compound emissions from stationary sources such as factories, printers, dry cleaners, and paint shops. Ozone is shorter lived than its precursors, which may build up and redistribute geographically over an extended period of calm wind conditions (air stagnation). Therefore, ozone concentrations show a very strong diurnal (daily) and seasonal cyclical character, with the height of the cycles controlled almost entirely by meteorological conditions.

The 1-hour National Ambient Air Quality Standard (NAAQS) for ozone is defined in terms of the daily maximum hourly average. The primary and secondary standards for ozone are 0.12 ppm hourly average concentration. The standard is attained when over the most recent three calendar years, the average number of exceedant days is not greater than one. An exceedant day is one during which one or more observed hourly concentrations exceeds 0.12 ppm.

On July 18, 1997 the United States Environmental Protection Agency (EPA) promulgated new national ambient air quality standards for ozone. EPA replaced the current 1-hour NAAQS with an 8-hour standard at a level of 0.08 parts per million (ppm). An ambient air quality monitoring site will meet the NAAQS for ozone when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. The new primary standard provides increased protection to the public, especially children and other at-risk populations, against longer exposure periods. The new secondary standard provides increased protection against ozone induced effects on vegetation. The current 1-hour NAAQS will not be revoked in the Metropolitan Washington area until this region has attained the 1-hour standard. This will ensure a smooth, legal, and practical transition to the new 8-hour NAAQS.

**Table 1: Ozone 1-hour**

	SEVEN CORNERS	MOUNT VERNON	CUB RUN	LEWINSVILLE	FRANCONIA
Highest daily max 1-hr conc., ppm	.127	.127	.129	.123	.118
2 <sup>nd</sup> highest daily max 1-hr conc., ppm	.124	.126	.127	.104	.112
99 <sup>th</sup> percentile conc., ppm of all 1-hr measurements	.092	.096	.092	.084	.101
Number of 1-hr measurements	8439	6988	8570	7667	2754
Number of hours above 0.12 ppm	3	7	7	1	0
Number of exceedant days, 1998	1	2	2	0	0
Average no. of exceedant days, 1996-1998	0.7	1.0	0.7	0	0

**Table 2: Ozone 8-hour**

	SEVEN CORNERS	MOUNT VERNON	CUB RUN	LEWINSVILLE	FRANCONIA
Highest daily max 8-hr conc., ppm	0.109	0.111	0.117	0.105	0.105
4 <sup>th</sup> highest daily max 8-hr conc., ppm	0.099	0.101	0.103	0.090	0.097
99 <sup>th</sup> percentile 8-hr conc., ppm	0.103	0.101	0.105	0.092	N/A
Number of days with 8-hr conc. greater than 0.08 ppm, 1998	17	17	16	7	14
Average of 4 <sup>th</sup> highest 8-hr conc., ppm, 1996-1998	0.092	0.092	0.087	0.082	N/A

The Franconia site designated as a Photochemical Ambient Air Monitoring Station (PAMS) began operation in 1998.

This is a Virginia Department of Environmental Quality site, for which Fairfax County provides operational assistance through a cooperative agreement. Ozone sampling commenced July 1998.

Ozone is an irritant to the respiratory system, mucous membranes and eyes. Exposure to ozone causes short term effects such as shortness of breath, eye and respiratory irritation as well as pulmonary function impairment. Chronic effects of repeated exposure can result in degeneration of the lung, acceleration of the natural aging process of the lung, and an increase in the body's susceptibility to disease. Individuals with existing respiratory impairments such as asthmatics have increased sensitivity to the effects of ozone. Healthy adults engaged in moderate physical activity are susceptible to the effects of ozone, as are children. In addition to health effects, ozone can have an adverse effect on many plants, weaken certain fabrics and rubber, and fade dyes.

## **2. Carbon Monoxide (CO)**

Carbon monoxide is a colorless, odorless gas produced by incomplete combustion of carbon compounds in fuels. The primary source of carbon monoxide is motor vehicle exhaust, although other fuel combustion processes such as wood burning stoves, incinerators and industrial sources may be important. Diurnal and seasonal patterns of carbon monoxide concentrations can be detected which correspond to human activities and meteorological factors. Concentrations are generally higher in vicinities of heavy vehicular traffic and fall off rapidly as the distance from a roadway increases. Elevated levels of CO are a winter time phenomena due to inefficient fuel combustion and weather conditions that hamper dispersion. CO is also known to be a participant in the photochemical reactions of ozone formation.

The NAAQS for CO specifies upper limits for one-hour and eight-hour averages. The primary and secondary standards for the 1-hr level are 35 ppm and the 8-hr level is 9 ppm, neither is to be exceeded more than once per year. The 8-hr standard is generally more restrictive.



Carbon monoxide exposure through inhalation enters the blood stream and reacts chemically with hemoglobin, thereby reducing delivery of oxygen to the body's tissues and organs. The heart and central nervous system are dependent on oxygen utilization; therefore, these are the organ systems most affected by CO exposure. The effects of CO can worsen the conditions of people with chronic heart disease. Other groups more susceptible to the effects of CO are individuals with anemia, pregnant women, infants, elderly people, and fetuses. Low levels of CO exposure may produce symptoms of headache, dizziness, impairment of visual perception, mental function and manual dexterity. High levels may be fatal; however, high exposure levels are unlikely in ambient conditions.

**Table 3: Carbon Monoxide**

	SEVEN CORNERS	CUB RUN	LEWINSVILLE
Annual arithmetic mean, ppm	0.616	0.424	0.732
Maximum 8-hr conc., ppm	5.2	1.2	2.4
2 <sup>nd</sup> highest 8-hr conc., ppm	1.7	1.1	2.3
Maximum 1-hr conc., ppm	3.3	1.8	5.0
2 <sup>nd</sup> highest 1-hr conc., ppm	3.0	1.7	4.4
99 <sup>th</sup> percentile 1-hr conc., ppm	1.6	1.1	2.5
Number of 1-hr measurements	8606	8500	8642
Number of 8-hr conc. above 9 ppm	0	0	0

### 3. Sulfur Dioxide (SO<sub>2</sub>)

Sulfur dioxide is formed by the combustion of sulfur containing fossil fuels. SO<sub>2</sub> is produced primarily from coal and oil combustion sources such as electric utilities, steel mills, refineries, pulp and paper mills and nonferrous smelters. Sulfur dioxide is an irritant to the nose, throat, lungs, and eyes. Health effects of SO<sub>2</sub> exposure are highly correlated with particulate pollution. High concentrations may affect breathing and aggravate existing respiratory and cardiovascular disease. Subgroups of the population that are especially susceptible to the effects of SO<sub>2</sub> include asthmatics, individuals with bronchitis or emphysema, children and the elderly. Sulfur dioxide is a primary contributor to acid deposition, through atmospheric chemical conversions, causing acidification of water systems, and damage to trees, crops, buildings and statues.

The NAAQS for sulfur dioxide are defined in terms of the annual arithmetic mean concentration, the maximum 24-hour concentration and the maximum 3-hour concentration. The primary standards are expressed in terms of the annual arithmetic mean, set at 0.03 ppm, and the maximum 24-hour concentration, set at 0.14 ppm, which are not to be exceeded more than once per year. The secondary standard is expressed in terms of maximum 3-hour concentration, which is set at 0.5 ppm and is not to be exceeded more than once per year.

**Table 4: Sulfur Dioxide**

	SEVEN CORNERS	CUB RUN	LEWINSVILLE
Annual arithmetic mean, ppm	0.008	0.005	0.009
Maximum 24-hr conc., ppm	0.063	0.032	0.054
2 <sup>nd</sup> highest 24-hr conc., ppm	0.059	0.032	0.047
Maximum 3-hr conc., ppm	0.037	0.028	0.046
2 <sup>nd</sup> highest 3-hr conc., ppm	0.034	0.024	0.041
99 <sup>th</sup> percentile 1-hr conc., ppm	0.028	0.022	0.028
Number of 1-hr measurements	8613	6457	8654
Number of 24-hr averages above 0.14 ppm	0	0	0

#### 4. Oxides of Nitrogen (NO & NO<sub>2</sub>)

Oxides of nitrogen are formed by high temperature combustion in both mobile and stationary sources such as electric utility and industrial boilers. Nitric oxide is produced in abundance by these sources and under the influence of sunlight it reacts with certain organic compounds to both generate and destroy ozone and NO<sub>2</sub>. The NO concentration is highly variable and strongly seasonal in character (high in winter). The NO<sub>2</sub> concentration is more stable and shows little seasonal influence.

Nitrogen dioxide is a highly reactive oxidant and has a greater toxic potential than NO. Exposure to ambient concentrations of NO<sub>2</sub> may cause changes in airway responsiveness, lower resistance to respiratory infections, and reduce pulmonary function. Subgroups of the population that are especially susceptible to the effects of NO<sub>2</sub> exposure include asthmatics, persons with existing respiratory illness, i.e. emphysema and chronic bronchitis, and children. Studies are not definitive for health effects in healthy individuals. Nitrogen oxides injure vegetation, cause fabrics and dyes to deteriorate, and contribute to metal corrosion. They are important participants in photochemical reactions of ozone formation and acid precipitation.

The NAAQS for nitrogen dioxide are defined in terms of the annual arithmetic mean concentration. The primary and secondary standards are 0.053 ppm. No NAAQS have been established for Nitric Oxide.

**Table 5: Oxides of Nitrogen**

	SEVEN CORNERS	CUB RUN	LEWINSVILLE
<b>NITRIC OXIDE (NO)</b>			
Annual arithmetic mean, ppm	0.012	0.007	0.024
99 <sup>th</sup> percentile 1-hr conc., ppm	0.094	0.067	0.233
Number of 1-hr measurements	8101	8169	7293
<b>NITROGEN DIOXIDE (NO<sub>2</sub>)</b>			
Annual arithmetic mean, ppm	0.023	0.011	0.022
99 <sup>th</sup> percentile 1-hr conc., ppm	0.053	0.034	0.058
Number of 1-hr measurements	8101	8169	7293

## **5. Particulate Matter**

Particulate matter consists of dust, smoke, and other solid or liquid particles small enough to suspend readily in the air. The particles range in size from very fine (a fraction of a micrometer) to the very coarse (about 1000 micrometers). The chemical and physical properties of particulate matter can vary greatly with time, region, meteorology, and type of source. Particulate matter has been associated with increased respiratory symptoms and illnesses in children and adults, and at very high levels has been shown to produce mortality in the elderly and ill.

The Environmental Protection Agency (EPA) revised the NAAQS for particulate matter on July 18, 1997. EPA added standards for particulate matter 2.5 micrometers and below ( $PM_{2.5}$ ) and revised the form of the 24-hour standard for particulate matter 10 micrometers and below ( $PM_{10}$ ). The  $PM_{2.5}$  standards are intended to protect against exposures to fine fraction particle pollution and the  $PM_{10}$  standards are intended to protect against coarse fraction particles. Fairfax County has retained total suspended particulate (TSP) standards which are intended to protect against welfare effects such as soiling and materials damage.

### **a. Total Suspended Particulate (TSP)**

The TSP measure is the weight of material in a unit volume of air, without regard to the size of the particles. The TSP sampler collects particulate matter up to a nominal size (aerodynamic diameter) of 25 to 45 micrometers. Each sample is collected during a 24-hour period, midnight to midnight. A maximum of 61 samples were scheduled for each station during 1998.

County primary and secondary standards are  $60 \mu\text{g}/\text{m}^3$  for annual geometric mean and  $150 \mu\text{g}/\text{m}^3$  for maximum 24-hour concentration, the 24-hour concentration is not to be exceeded more than once per year.

**Table 6: Total Suspended Particulates**

	MOUNT VERNON	GUNSTON*	SPRINGFIELD	ALL STATIONS
Number of samples	54	59	52	165
Annual geometric mean, $\mu\text{g}/\text{m}^3$	31.66	26.83	40.00	32.16
Maximum 24-hr sample, $\mu\text{g}/\text{m}^3$	82.5	71.9	93.4	93.4
2 <sup>nd</sup> highest 24-hr sample, $\mu\text{g}/\text{m}^3$	69.5	52.4	74.1	74.1

**Table 7: Total Suspended Particulates**  
Monthly Geometric Mean,  $\mu\text{g}/\text{m}^3$ 

	MOUNT VERNON	GUNSTON	SPRINGFIELD	ALL STATIONS
January	27.5	17.5	30.4	24.46
February	32.0	26.9	61.8	37.61
March	28.0	25.5	37.1	29.81
April	37.4	37.8	48.3	40.87
May	30.8	23.6	41.0	31.00
June	28.2	25.1	34.9	29.12
July	49.5	40.8	39.5	43.05
August	26.9	28.6	40.6	31.49
September	34.9	31.3	48.7	37.61
October	30.4	27.8	28.1	28.74
November	25.8	28.1	34.3	29.19
December	28.4	19.0	41.7	28.23

## b. Particulate Matter 10 Micrometers (PM<sub>10</sub>)

The PM<sub>10</sub> measurement is a size specific indicator of particulate matter in the ambient air. The PM<sub>10</sub> sampler collects particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers. The PM<sub>10</sub> measure is the weight of this size specific material in a unit volume of air.

The National Ambient Air Quality Standards (NAAQS) are defined in terms of the 24-hour average concentration and the annual arithmetic mean. The primary standard for 24-hour average concentration is 150 µg/m<sup>3</sup>. In 1997, EPA revised the form of the 24-hour standard. The standard is attained when the 3-year average of the 99th percentile of the monitored concentrations at the highest monitor in an area is less than or equal to 150 µg/m<sup>3</sup>. The primary standard for annual arithmetic mean is 50 µg/m<sup>3</sup>. The standard is attained when the 3-year average of the annual arithmetic PM<sub>10</sub> concentrations at each monitor within an area is less than or equal to 50 µg/m<sup>3</sup>.

**Table 8: Particulate Matter 10 Micrometers**

	CUB RUN	MOUNT VERNON	LEWINSVILLE	SEVEN CORNERS	SPRINGFIELD	ALL STATIONS
Number of samples	52	49	44	43	54	242
Annual arithmetic mean, µg/m <sup>3</sup>	17.97	22.22	19.74	18.83	21.08	19.97
Maximum 24-hr sample, µg/m <sup>3</sup>	48.9	65.2	44.9	49.6	50.5	65.2
99 <sup>th</sup> percentile of 24-hr samples, µg/m <sup>3</sup>	48.9	65.2	44.9	49.6	50.5	51.8
24-hr samples above 150 µg/m <sup>3</sup>	0	0	0	0	0	0

**Table 9: Particulate Matter 10 Micrometers**  
Monthly Arithmetic Mean,  $\mu\text{g}/\text{m}^3$

	CUB RUN	MOUNT VERNON	LEWINSVILLE	SEVEN CORNERS	SPRINGFIELD	ALL STATIONS
January	15.8	16.1	15.6	12.8	13.9	14.97
February	20.7	22.2	20.7	16.9	18.5	19.77
March	15.3	20.4	13.7	13.8	13.6	15.36
April	18.4	22.6	19.4	19.2	22.3	20.36
May	11.0	12.4	11.8	11.9	10.8	11.58
June	20.8	18.6	20.5	21.6	21.6	20.64
July	23.4	44.4	19.4	42.5	33.9	32.69
August	22.2	25.8	25.3	N/A*	21.4	24.39
September	26.3	25.0	25.0	24.4	24.5	25.04
October	21.0	23.2	19.2	22.1	23.1	21.74
November	14.4	24.0	15.1	16.1	19.9	17.50
December	14.9	15.3	N/A**	N/A**	12.7	14.93

\*No data collected for August due to instrument malfunction.

\*\*Sampling terminated for  $\text{PM}_{10}$ ; sampling will be initiated for  $\text{PM}_{2.5}$  in 1999.

**b. Particulate Matter 2.5 Micrometers (PM<sub>2.5</sub>)**

The PM<sub>2.5</sub> measurement is a size specific indicator of particulate matter in the ambient air. The PM<sub>2.5</sub> sampler collects particulates with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. The PM<sub>2.5</sub> measurement is the weight of this size specific material in a unit volume of air.

The new primary annual PM<sub>2.5</sub> standard is set at 15 µg/m<sup>3</sup>, annual arithmetic mean. The annual standard is attained when the 3-year average of the annual arithmetic mean PM<sub>2.5</sub> concentrations is less than or equal to 15 µg/m<sup>3</sup> from single or multiple community-oriented monitors. The new primary 24-hour PM<sub>2.5</sub> standard is set at 65 µg/m<sup>3</sup>. The 24-hour PM<sub>2.5</sub> standard is attained when the 3-year average of the 98th percentile of the 24-hour PM<sub>2.5</sub> at each population-oriented monitor within an area is less than or equal to 65 µg/m<sup>3</sup>.

PM<sub>2.5</sub> standards will require new and improved instrumentation to measure ambient fine particulate pollution and the design of a national network of samplers. Along with the standards, EPA promulgated new Federal Reference and Equivalent methods for measuring PM<sub>2.5</sub>, and guidance on network design, siting, and quality assurance of samplers. EPA proposed that the PM<sub>2.5</sub> networks would be expected to be completed within 3 years of the effective date of promulgation with a minimum number of samplers in operation by January 1, 1999. Virginia will receive approximately 28 PM<sub>2.5</sub> samplers from EPA, with 3 of these sited within Fairfax County. Preliminary sampling began during the winter of 1998-1999. It is anticipated that reliable data will be available midyear 1999. Future annual summaries will contain PM<sub>2.5</sub> data from these sites.



## 6. Lead (Pb)

Lead is emitted into the atmosphere by certain industries such as smelters and battery manufacturers. Airborne lead is associated with particles ranging between 0.1 and 5.0 micrometers in diameter. Particle size and shape are important factors in determining the deposition and suspension of lead in the atmosphere and the retention and absorption of lead into the human lung.

Lead interferes with the blood forming system, the nervous system, the renal system, vitamin D metabolism, and can affect the normal functions of the reproductive and cardiovascular systems. Certain subgroups of the population are more susceptible to the effects of lead. Low levels of lead absorption by young children can cause permanent mental retardation. Lead has also been associated with high blood pressure in adults.

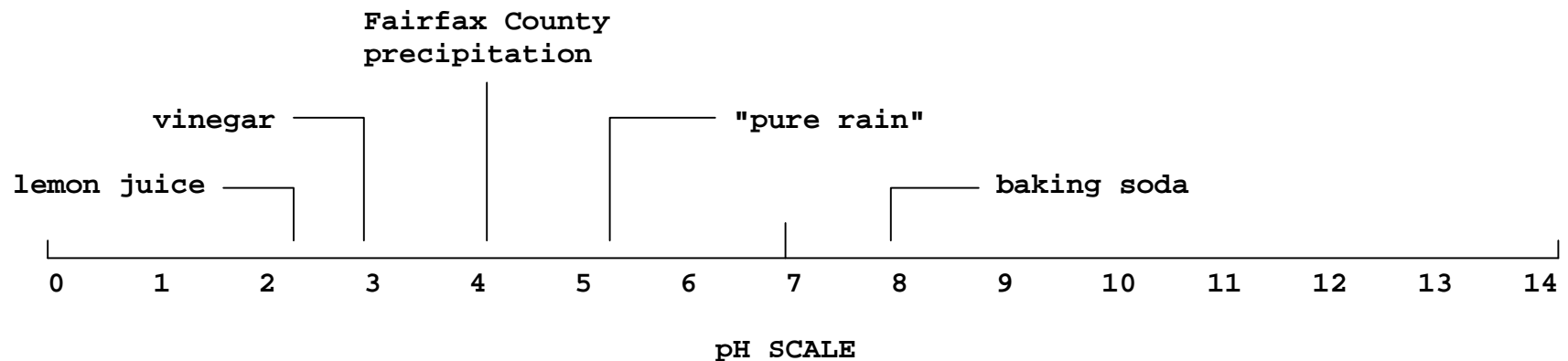
The NAAQS for lead are defined in terms of the quarterly arithmetic mean. The primary and secondary standards for lead are  $1.5 \mu\text{g}/\text{m}^3$  quarterly arithmetic mean.

**Table 10: Lead**

	MOUNT VERNON	SPRINGFIELD	I-95
Number of 24-hr measurements	55	52	55
Maximum 24-hr sample, $\mu\text{g}/\text{m}^3$	0.037	0.050	0.068
Maximum monthly average, $\mu\text{g}/\text{m}^3$	0.021	0.018	0.041
Maximum quarterly average, $\mu\text{g}/\text{m}^3$	0.011	0.011	0.025
2 <sup>nd</sup> highest quarterly average, $\mu\text{g}/\text{m}^3$	0.009	0.010	0.014

## D. Acid Deposition

Acidic precipitation is a phenomenon resulting primarily from the reaction of sulfur oxides and nitrogen oxides which in combination with atmospheric oxygen and moisture form sulfuric and nitric acids. These acids can then be deposited by wet deposition (rain, snow, ice, and fog). Rain and snow are the two primary mechanisms of deposition. In the absence of moisture intermediate products, sulfates, nitrates, and other aerosols are formed and deposited in dry form. The amount of acidity in precipitation can be determined by measuring the pH of a sample. pH is based on a logarithmic scale. A pH of 7.0 is neutral, less than 7.0 is acidic, and greater than 7.0 is basic. Since the scale is logarithmic, a pH change from 7.0 to 6.0 is a ten-fold increase in acidity.



In sensitive areas of the country, acidic precipitation has caused acidification of freshwater ecosystems such that aquatic life can no longer survive. Acidic precipitation is also suspected to be a corrosive which can damage statuary, stone structures, and automobile finishes. Direct effects upon humans have not been established.

Rain and snow samples are collected from our monitoring station at Occoquan, Virginia on a weekly basis. The samples are returned to our laboratory in Fairfax and are analyzed for pH and conductivity.

No standards have been established but "pure rain" should have a pH in the range of 5.2 to 5.6 due to its mixing with atmospheric carbon dioxide and other natural atmospheric constituents.

**Table 11: Acid Deposition Occoquan Hill Site**  
Monthly Volumetric Weighted Average

	pH <sup>*</sup>	CONDUCTIVITY <sup>*</sup> (μMHO)	TOTAL RAINFALL
January	3.69	17.61	5.79
February	3.87	14.55	7.17
March	4.01	14.87	5.97
April	4.03	15.70	3.67
May	3.93	13.96	5.10
June	3.95	23.25	5.52
July	3.69	33.86	2.16
August	3.79	40.68	0.95
September	3.63	46.59	1.87
October	3.91	22.35	0.66
November	4.00	16.67	1.05
December	4.09	20.43	1.96

**Table 12: Acid Deposition Occoquan Hill Site**  
Quarterly And Annual Volumetric Weighted Average

	pH <sup>*</sup>	CONDUCTIVITY <sup>*</sup> (μMHO)
First Quarter	3.88	15.24
Second Quarter	3.96	17.39
Third Quarter	3.71	41.23
Fourth Quarter	4.03	20.58
Annual 1998	3.91	18.97

\* Volume weighted average indicates what the level would be if all samples had been mixed together.

## E. Regional Air Quality

### 1. Regional Air Pollution Episodes

The U.S. Environmental Protection Agency (EPA) requires the use of a National Uniform Pollutant Standards Index (P.S.I.) for reporting air quality levels to the general public. The P.S.I. is a system which condenses five air pollutant concentration values (PM<sub>10</sub>, SO<sub>2</sub>, CO, O<sub>3</sub>, and NO<sub>2</sub>) into a single number as an indicator of air quality. The index values are then grouped into air quality descriptor categories as follows:

**Table 13: Air Quality Index (P.S.I.)**

Index Value	Episode Level	Descriptor Category
500	Emergency	
400		Hazardous
300	Warning	Hazardous
200	Alert	Very Unhealthful
100	(Health Advisory)	Unhealthful
50		Moderate
0		Good

The Metropolitan Washington Council of Governments (C.O.G.) is responsible for reporting daily air quality levels to the public in this region. C.O.G. collects air quality data from selected monitoring stations on a daily basis, calculates a maximum index value and descriptor category for the day, forecasts the air quality levels for the following day, and reports these to the media for dissemination to the public.

Whenever weather or air pollution conditions or both indicate that air quality levels have the potential to cause significant harm to public health an "air pollution episode" may be called by C.O.G. Air pollution episode stages of alert, warning, and emergency may be called depending on the severity of the episode. In this region, ozone is probably the only pollutant, which under specific weather conditions has the potential to trigger an alert stage episode. However, no alerts have ever been called in this region.

When the index exceeds or will probably exceed 100, the primary NAAQS level, and when specific weather conditions exist, a Health Advisory may be issued by C.O.G. This Health Advisory is directed towards sensitive populations such as the elderly and those with respiratory disorders. For ozone, an index of 100 corresponds to a concentration of 0.12 ppm. There were nine Health Advisory warnings issued during 1998.

During regional air pollution episodes or advisories, monitoring stations throughout the region are observed continuously. C.O.G. collects air quality data from these stations hourly as a basis for continuing or canceling the episode or advisory, and disseminates the information to the media.

EPA is in the process of revising the pollutant standard index, due to the promulgation of the new PM<sub>2.5</sub> and 8-hour ozone standards. The final revision will be reflected in next year's annual summary.

## 2. Regional Ozone Exceedances

The Washington DC, Maryland, and Virginia air quality control region is classified as a serious nonattainment area for ozone. This region has until 1999 to attain the ozone NAAQS of 0.12 ppm.

An exceedant day is a day when an ozone monitoring site exceeds the NAAQS of 0.12 ppm for at least one hour. There were six ozone exceedant days in the air quality control region in 1998. Fairfax County had three ozone exceedant days in 1998. It is shown in Table 14 below.

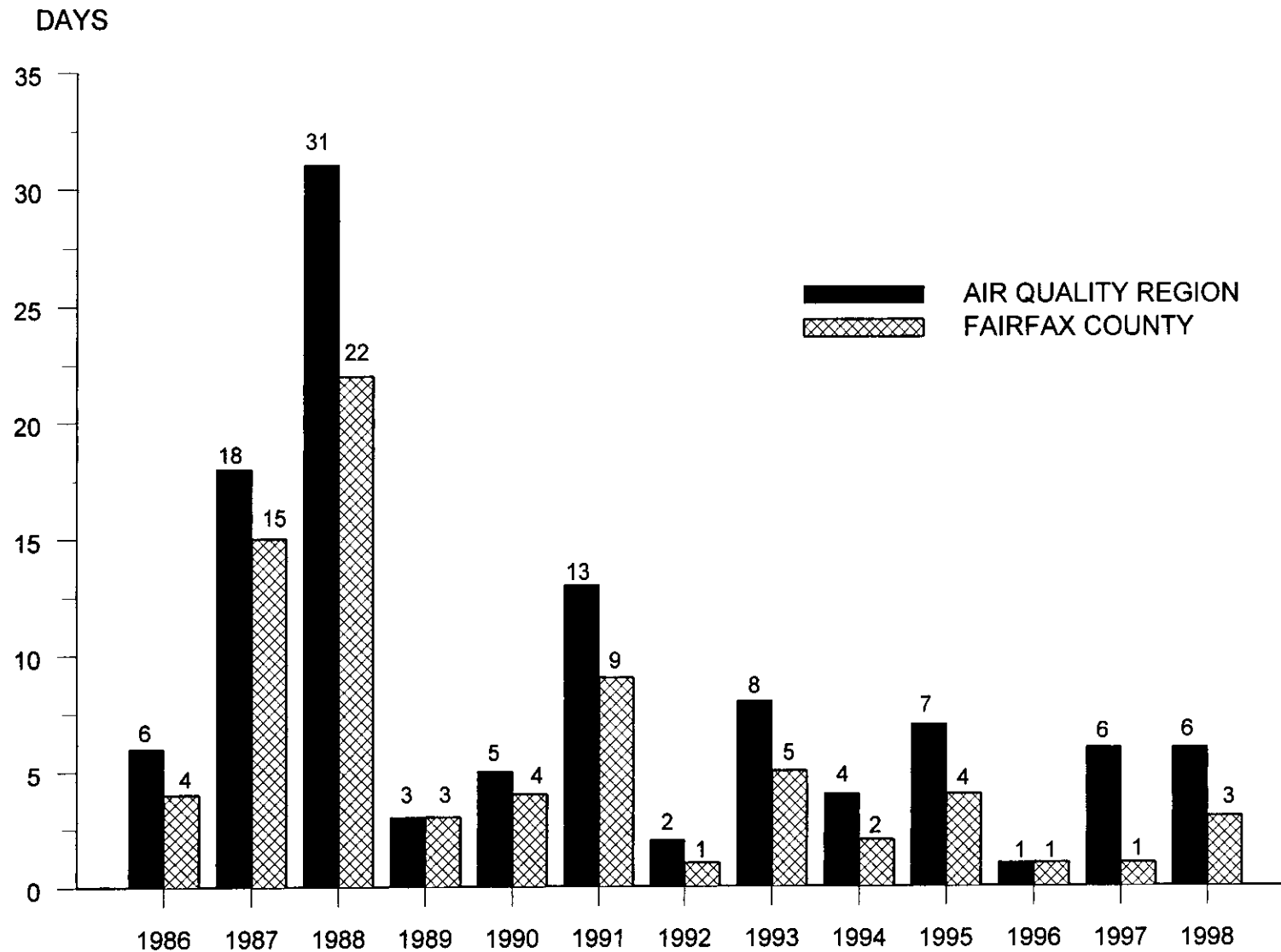
**TABLE 14: REGIONAL OZONE EXCEEDANCES**

DATE	LOCATION	MAXIMUM 1 HOUR OZONE (PPM)
July 30	*Cub Run, Upper Cub Run Drive, Chantilly, VA	0.129
	Greenbelt, MD	0.128
	Suitland, P.G. CO., MD	0.125
August 4	*Seven Corners, Montgomery Wards, Falls Church, VA	0.127
	*Mount Vernon, Sherwood Hall Lane, Mount Vernon, VA	0.127
	*Cub Run, Upper Cub Run Drive, Chantilly, VA	0.127
	Suitland, P.G. CO., MD	0.125
August 21	*Mount Vernon, Sherwood Hall Lane, Mount Vernon, VA	0.125
August 25	Greenbelt, MD	0.125
September 13	Stafford CO., VA	0.126
	Rockville, MD	0.136
September 14	Frederick CO., MD	0.131
	Stafford CO., VA	0.127

\*Fairfax County Monitoring Station

The following graph is a comparison of the number of ozone exceedant days observed in the air quality control region (including Fairfax County) with those observed just in Fairfax County.

# OZONE EXCEEDANT DAYS



## **F. METEOROLOGY**

### **1. Overview**

Pertinent and representative localized meteorological data are an essential and ongoing integral part of the County's air quality monitoring program. Continuous and accurate observations of local conditions relating to temperature, wind flow (speed and direction) and precipitation are fundamental elements used in the day to day evaluation and understanding of air quality conditions and assessment of long term trends within the County.

The County's meteorological observing equipment has evolved from simple battery powered, mechanical recorder devices requiring manual reduction of data to more modern electronic sensors and data average devices capable of real-time call up and output of instantaneous values or hourly and daily averages of temperature, wind and precipitation. Paramount along with these improvements, the meteorological sensors have always been employed in close proximity with the continuous air quality monitors to assure the most representative data practical.

Some meteorological data produced by other agencies at nearby locations are acquired and used by the agency. Data from Dulles and Washington National Airports and Davison Army Airfield (Ft. Belvoir), although tailored for aviation support, are particularly useful in establishing long term averages, for quality control work, and to compliment agency data. Therefore, some of the pertinent airport data are tabulated and displayed in this report.

County and agency computers, data loggers, and other electronic devices are exploited in the acquisition, reduction and processing of meteorological data. For this report, the data, unless otherwise described, is processed, tabulated and displayed in a manner similar to that done for the air quality pollutant data. In addition, data for this and all prior years are archived in the County's mainframe computer and is readily available for interested County and other governmental agencies, contractors, and Fairfax County citizens.

The meteorology section is supplemented with graphical representations of monthly trend data for 1998 contained in Appendix A. Meteorological trend analysis and data, including graphs showing multi-year trends, are contained in Appendix B. Location and descriptions of the air quality and meteorological monitoring stations are contained in Appendix C.



## 2. Temperature

The annual average maximum or minimum temperature is obtained by averaging all daily maximum or minimum temperatures. The annual mean value is the average of all hourly average temperature observations, and is independent of any recorded or calculated maximum or minimum.

**Table 15: Temperature**

	Annual Average Daily Maximum EF	Annual Mean Temperature EF	Annual Average Daily Minimum EF
	Maximum	Mean	Minimum
<b>COUNTY STATIONS</b>			
Seven Corners	65.5	58.1	50.7
Lewinsville	68.4	59.8	50.9
Mount Vernon	69.4	59.3	49.4
Occoquan Hill	68.8	59.4	50.7
Luck Quarry	69.9	58.1	46.6
<b>AIRPORTS</b>			
Dulles	68.4	57.6	45.8
National	68.5	59.9	51.6
Davison	72.5	61.3	50.4

### 3. Rainfall

Rainfall is stated as the accumulated depth in inches as measured by county and airport rain gauges. The first half of the year, January through June, was very wet, 11.83 inches above normal. The last half of the year, July through December, was very dry, 12.70 inches below normal. This led to an overall deficit of 0.87 inches for the year. (See figure A-11)

**Table 16: Rainfall**

RAINFALL (inches)	
<b>COUNTY STATIONS</b>	
Cub Run	39.75
Seven Corners	38.75
Lewinsville	37.72
Mount Vernon	41.93
Occoquan Hill	41.87
Luck Quarry	41.33
<b>AIRPORTS</b>	
Dulles	37.43
National	35.95
Davison	43.55
<b>ANNUAL COUNTYWIDE MEAN</b>	39.81
<b>LONG TERM MEAN FROM THREE AIRPORT SITES</b>	40.68

#### 4. Wind

Wind direction observations are grouped by quadrant as follows: All occurrences of wind from 349° true through 078° true inclusive are classed as northeast winds; similarly winds from 079° through 168° true are southeast; winds from 169° through 258° true are southwest; and winds from 259° through 348° true are northwest. Frequency is the number of hourly observations in a quadrant stated as a percentage of all wind observations. Similarly, the mean wind speed for a quadrant is the average of all hourly wind speeds whose associated directions fall within the quadrant.

**Table 17: Wind Direction and Mean Wind Speed**

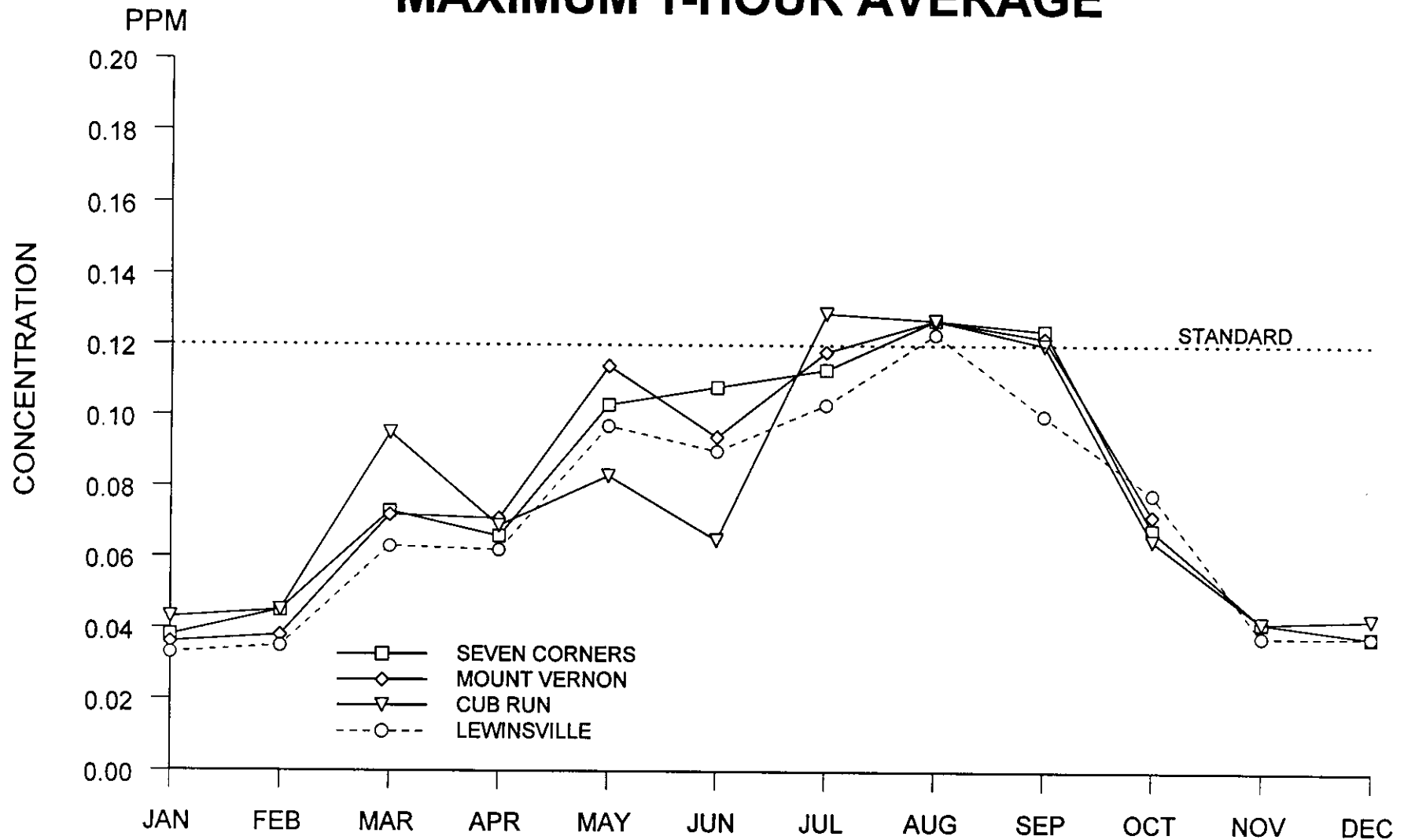
Table Format: Frequency (percent of time)  
Miles per hour

	NORTHEAST	SOUTHEAST	SOUTHWEST	NORTHWEST	CALM
<b>COUNTY STATIONS</b>					
Seven Corners	14.9 4.3	20.0 4.8	33.9 6.2	29.3 5.5	1.9
Lewinsville	18.3 3.1	20.2 2.9	19.6 3.7	41.6 3.9	0.3
Luck Quarry	15.9 3.9	16.6 3.0	24.1 4.4	33.7 3.9	9.7
Mount Vernon	21.9 3.3	22.9 3.3	24.4 4.4	30.2 4.3	0.6
Occoquan Hill	11.2 5.2	13.5 3.2	13.1 3.7	38.5 5.6	23.7
<b>AIRPORTS</b>					
Dulles	21.8 7.6	8.3 6.3	22.7 8.0	25.3 9.5	22.0
National	22.3 9.1	12.0 7.4	30.3 8.8	28.2 11.0	7.2
Davison	27.2 3.4	21.4 4.1	16.5 5.3	33.4 8.6	1.5

# **APPENDIX A**

## **MONTHLY TREND GRAPHS**

# OZONE MAXIMUM 1-HOUR AVERAGE



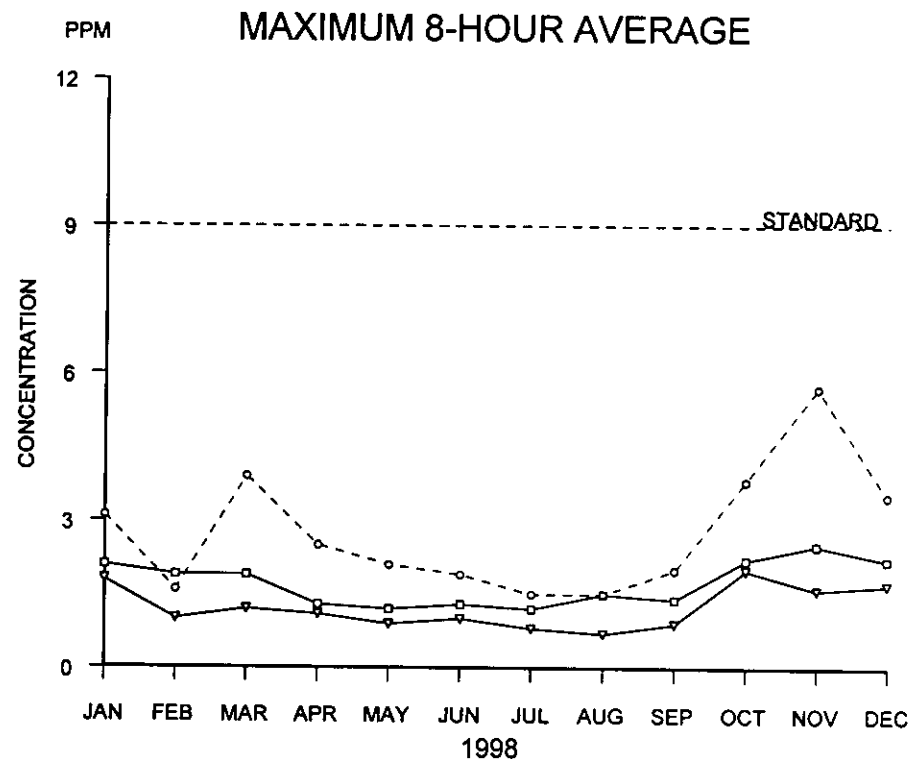
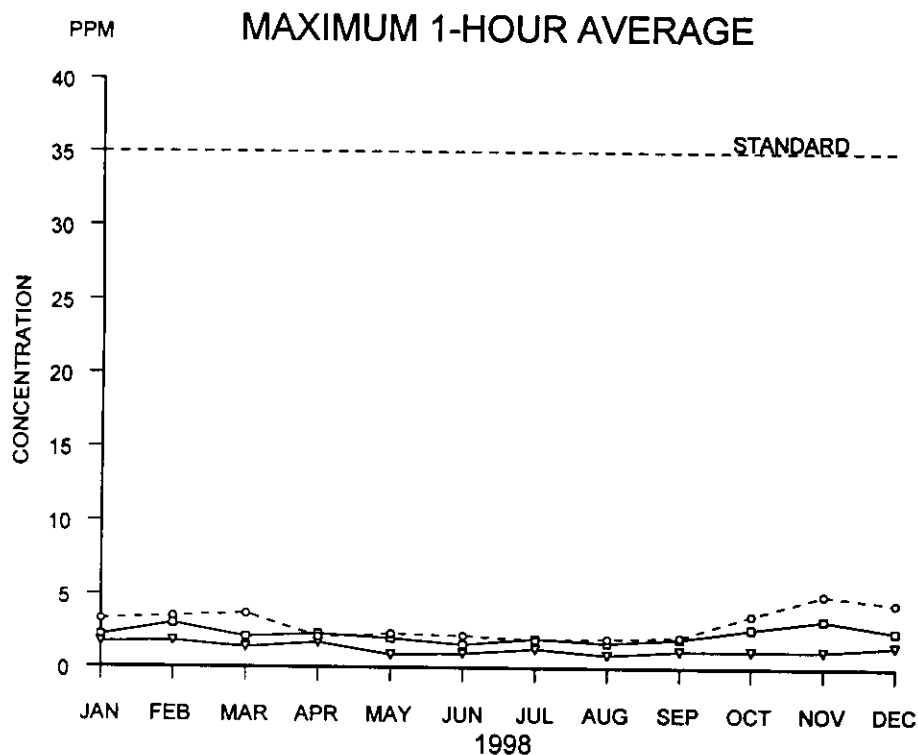
FEDERAL, STATE, AND COUNTY STANDARD:

PRIMARY: 0.12 PPM MAXIMUM 1-HOUR CONCENTRATION.

SECONDARY: SAME AS PRIMARY

1998

# CARBON MONOXIDE



## FEDERAL, STATE, AND COUNTY STANDARDS:

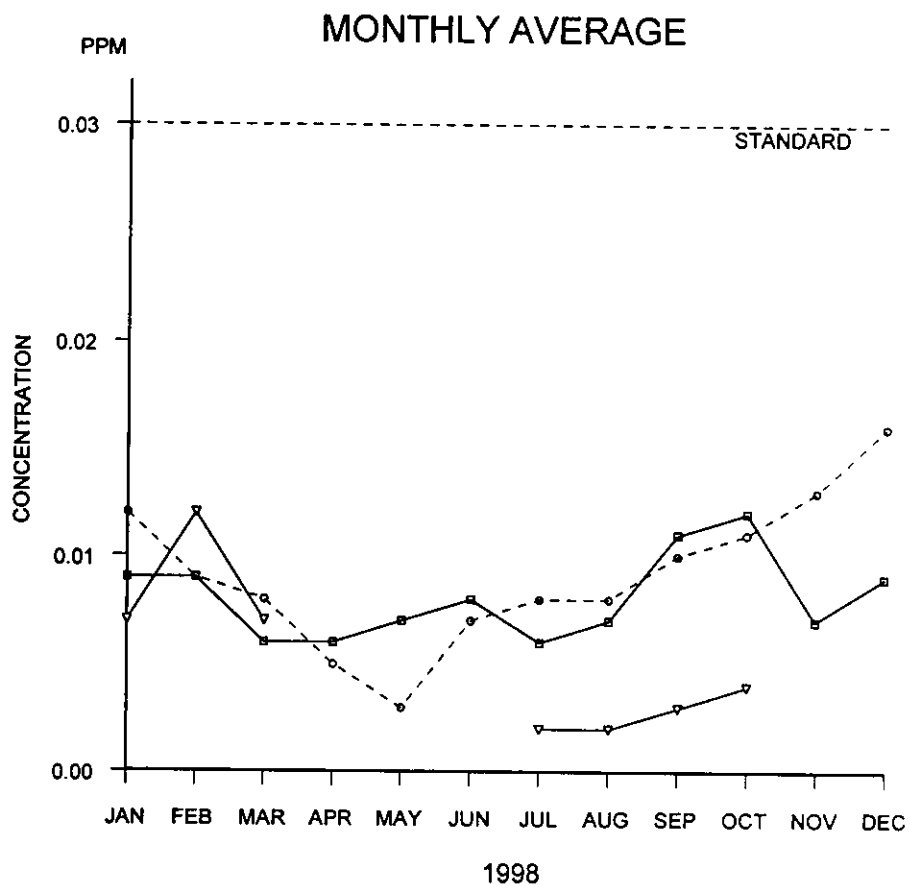
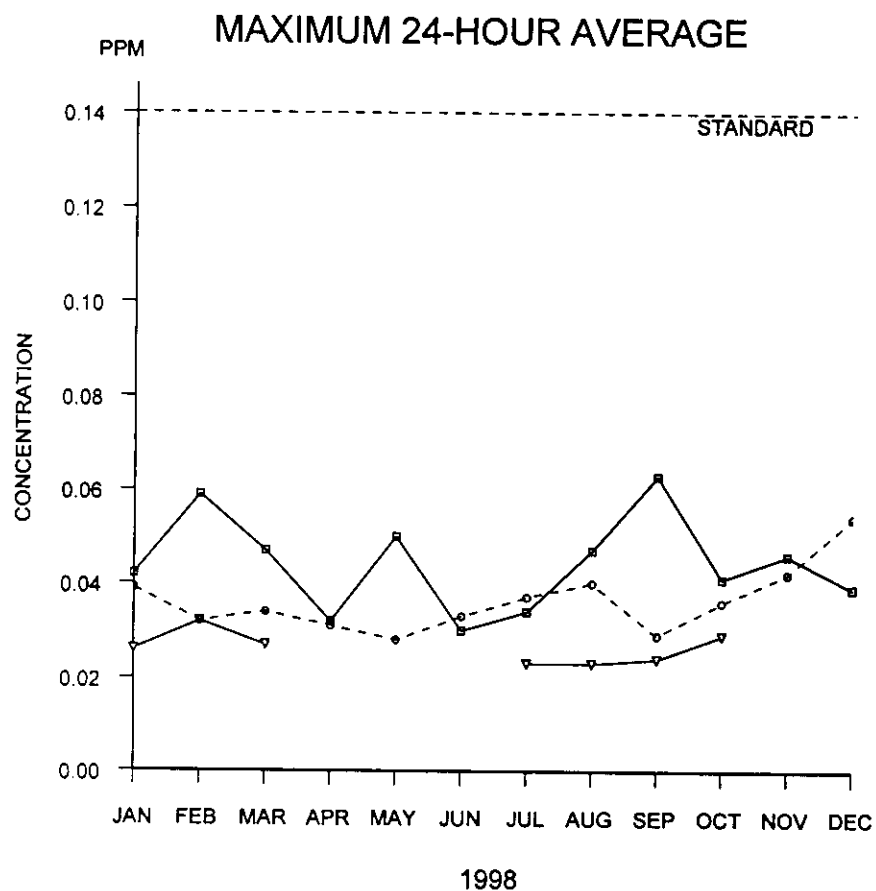
PRIMARY: 1) 35 PPM MAXIMUM 1-HOUR CONCENTRATION,  
NOT TO BE EXCEEDED MORE THAN ONCE PER YEAR.

2) 9 PPM MAXIMUM 8-HOUR CONCENTRATION,  
NOT TO BE EXCEEDED MORE THAN ONCE PER YEAR.

SECONDARY: SAME AS PRIMARY.

—□— SEVEN CORNERS  
—▽— CUBRUN  
---○--- LEWINSVILLE

# SULFUR DIOXIDE



—●— CUBRUN  
 - - - ● - - - LEWINSVILLE  
 —■— SEVEN

## FEDERAL, STATE, AND COUNTY STANDARDS:

PRIMARY: 1) 0.03 PPM ANNUAL ARITHMETIC MEAN.

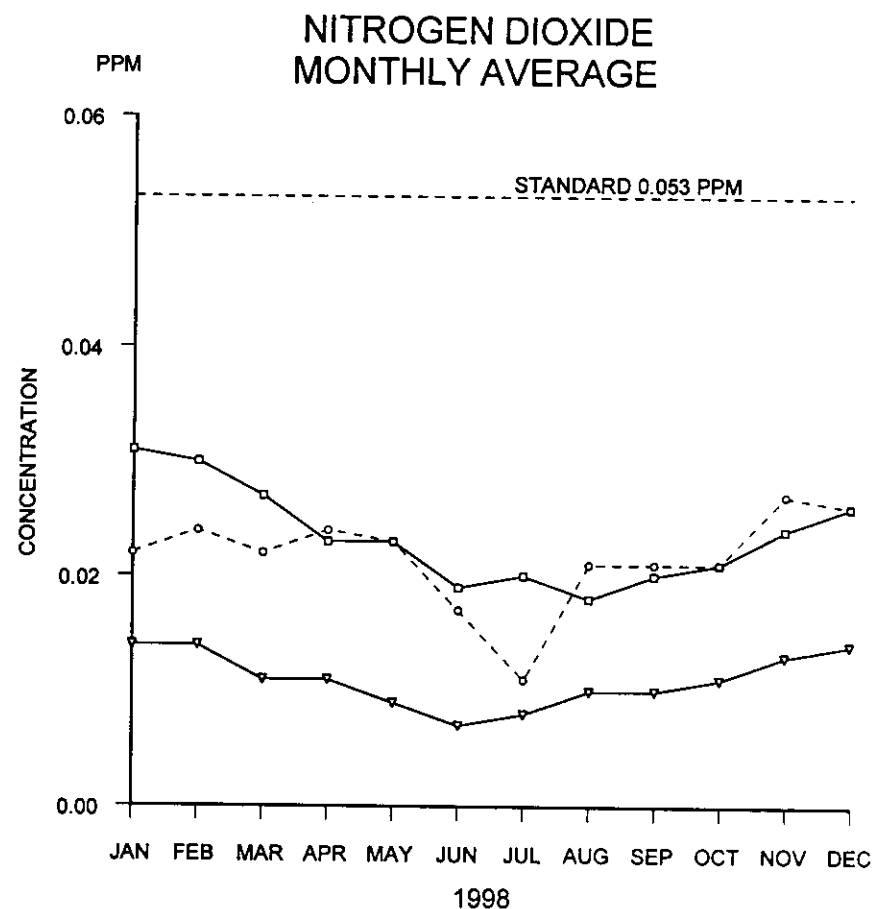
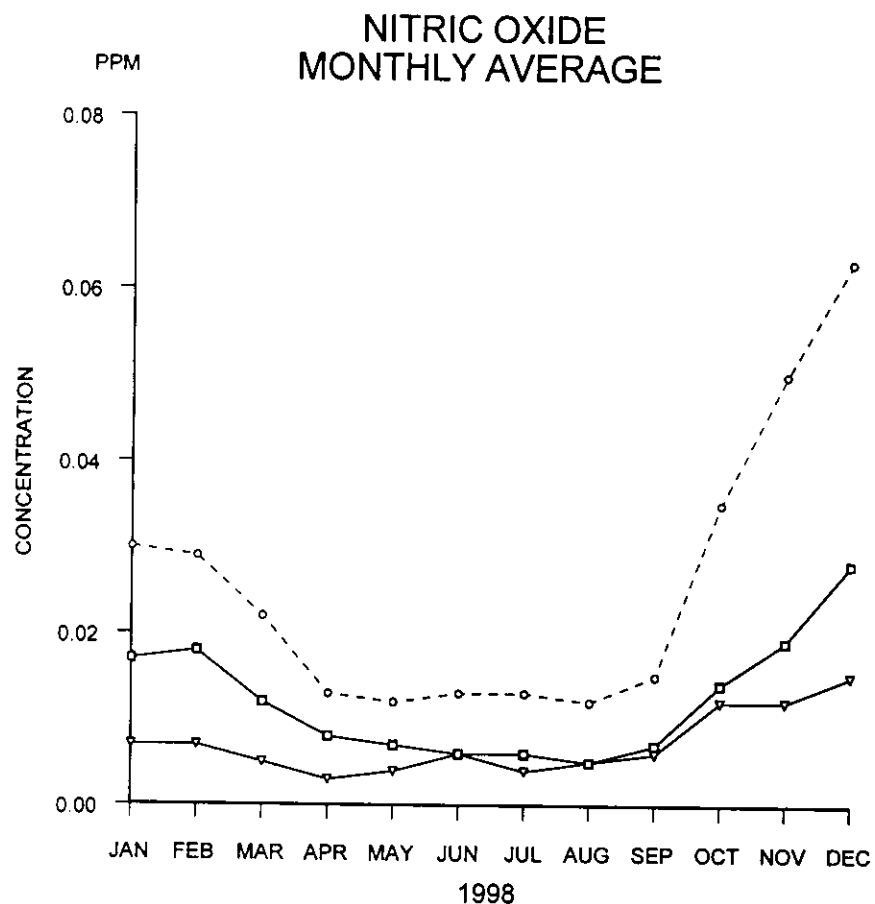
2) 0.14 PPM MAXIMUM 24-HOUR CONCENTRATION.

SECONDARY: 0.5 PPM MAXIMUM 3-HOUR CONCENTRATION,

NOT TO BE EXCEEDED MORE THAN ONCE PER YEAR.

\* Not enough data collected at Cub Run site for April - June, and November and December.

# OXIDES OF NITROGEN



FEDERAL, STATE, AND COUNTY STANDARDS:

NITROGEN DIOXIDE:

PRIMARY: 0.053 PPM ANNUAL ARITHMETIC MEAN.

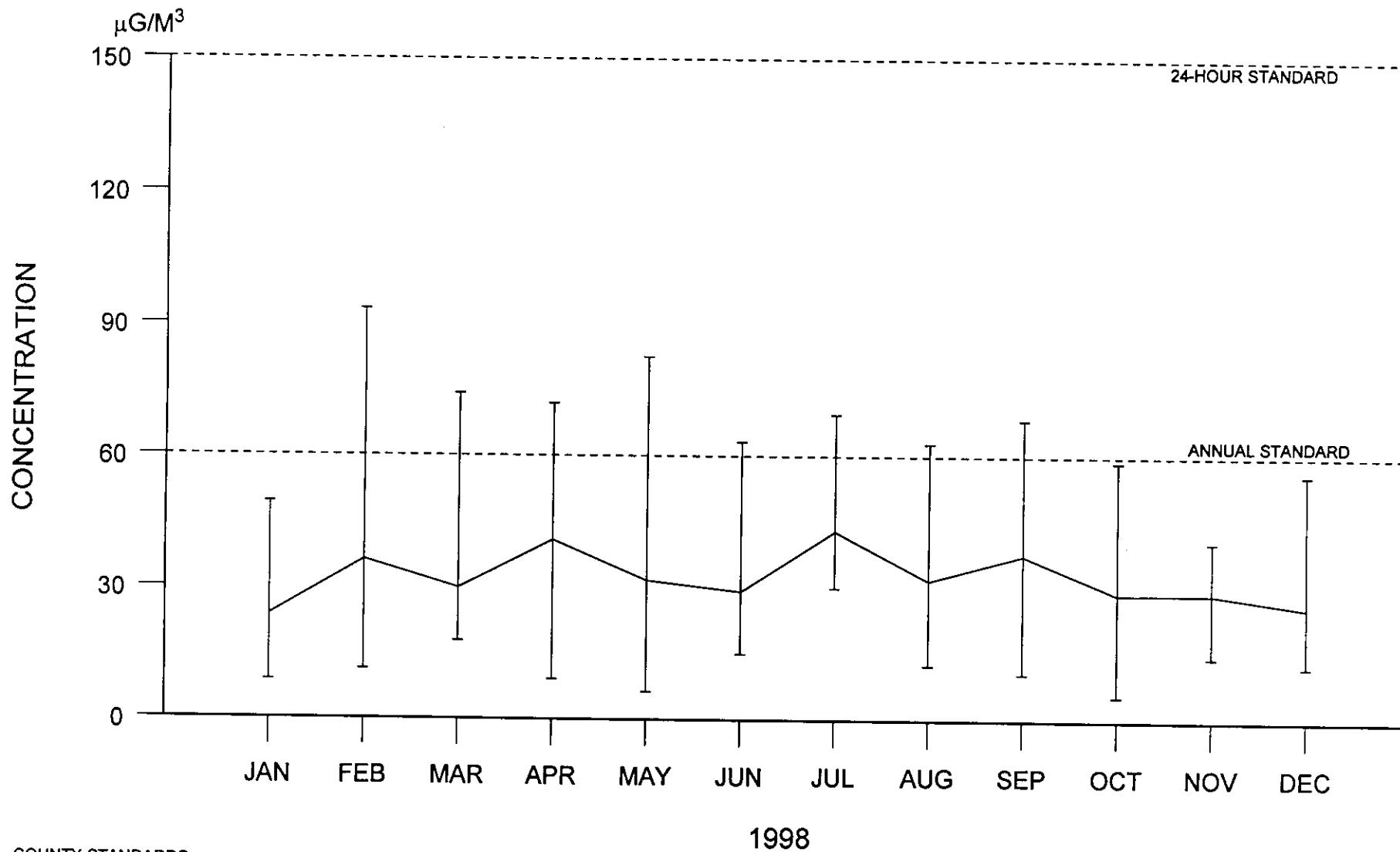
SECONDARY: SAME AS PRIMARY

NITRIC OXIDE: NO STANDARD ESTABLISHED.

—○— SEVEN CORNERS  
—□— CUBRUN  
---◇--- LEWINSVILLE



# **TOTAL SUSPENDED PARTICULATES MONTHLY GEOMETRIC MEAN WITH MAXIMUM / MINIMUM 24-HOUR SAMPLES**

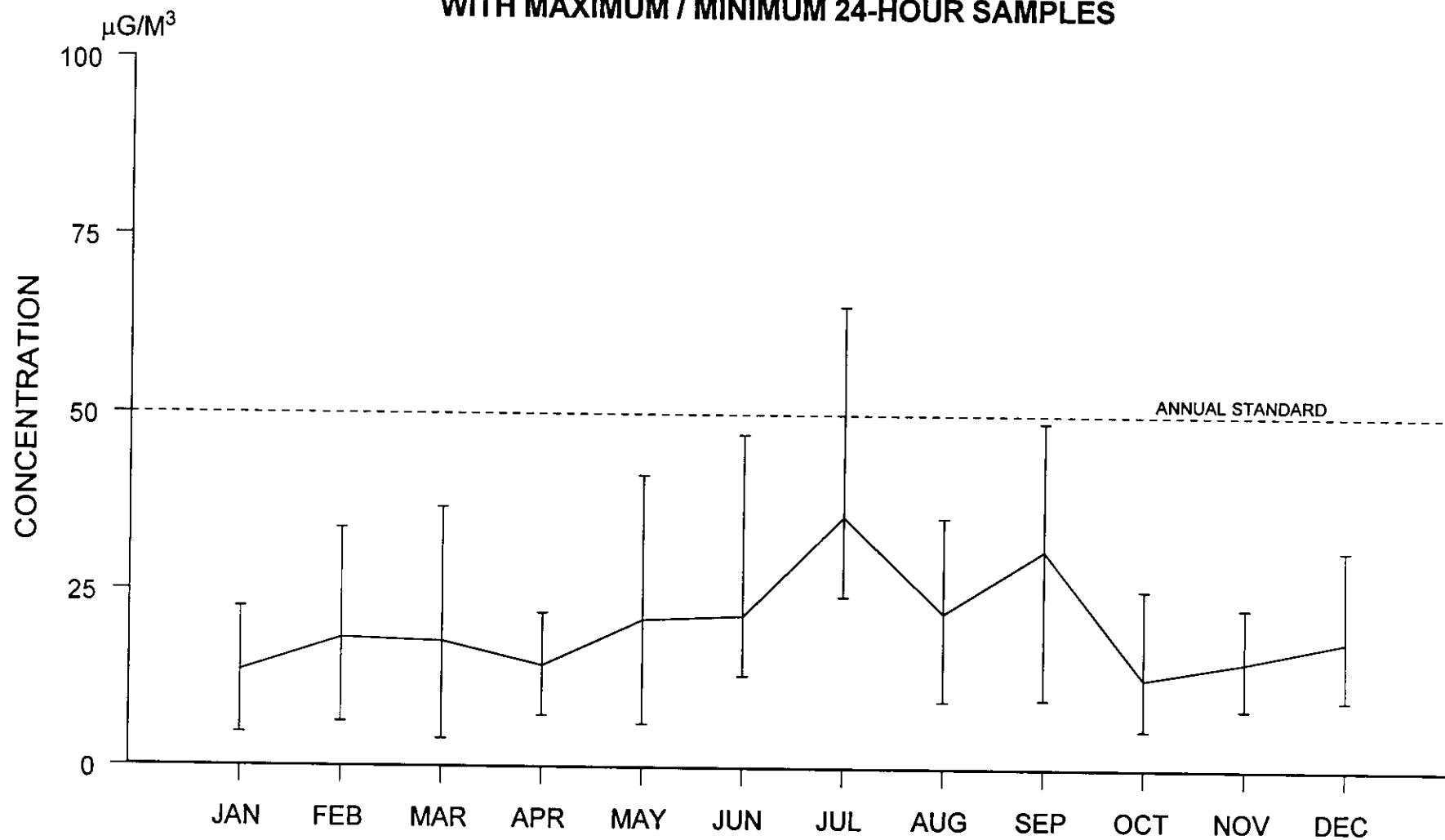


COUNTY STANDARDS:

60  $\mu\text{G}/\text{M}^3$  ANNUAL GEOMETRIC MEAN.

150  $\mu\text{G}/\text{M}^3$  MAXIMUM 24-HOUR CONCENTRATION, NOT TO BE EXCEEDED MORE THAN ONCE PER YEAR.

# PARTICULATE MATTER PM<sub>10</sub> MONTHLY ARITHMETIC MEAN WITH MAXIMUM / MINIMUM 24-HOUR SAMPLES



## FEDERAL, STATE, AND COUNTY STANDARDS:

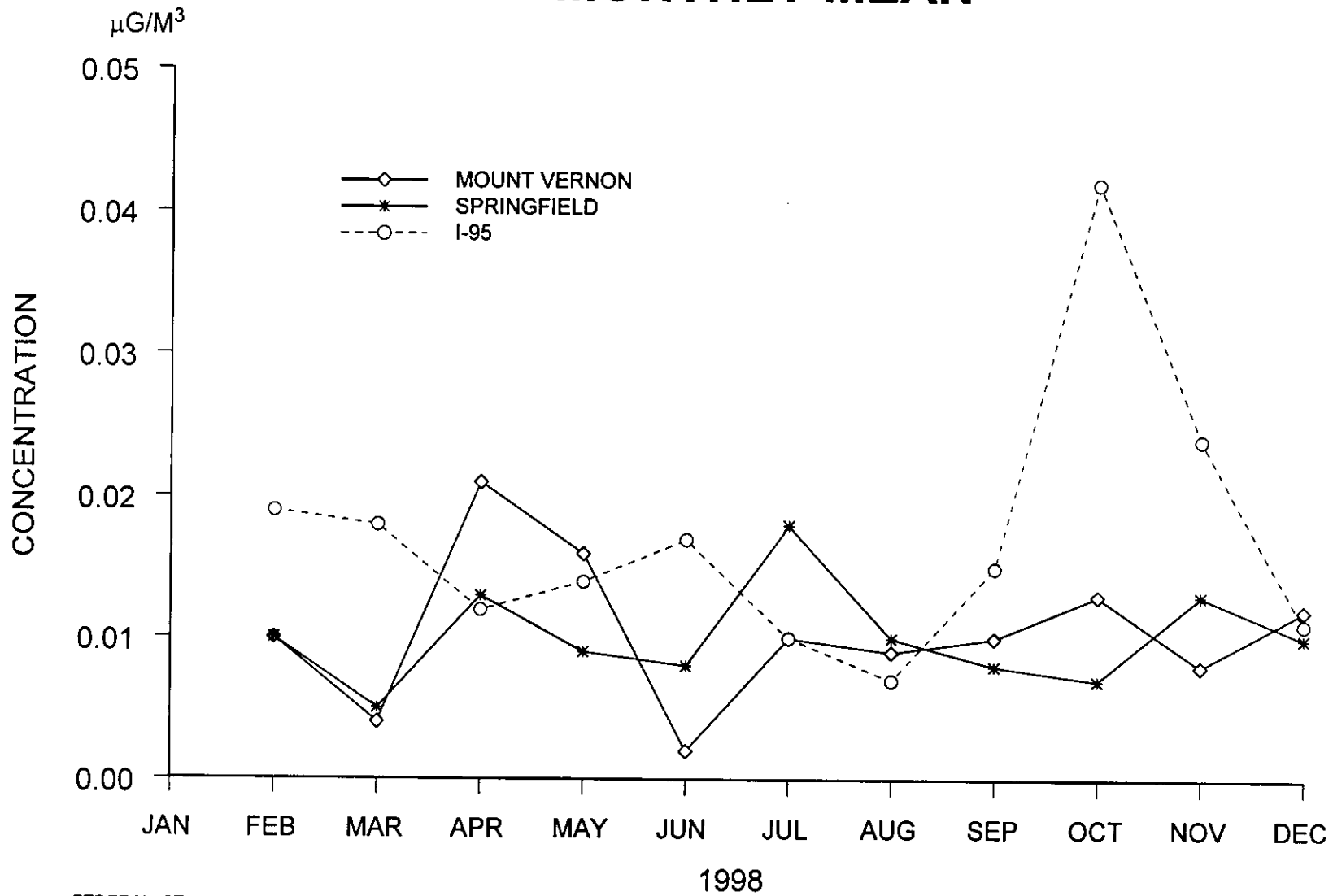
1998

PRIMARY: 50 μG/M³ ANNUAL ARITHMETIC MEAN, 3-YEAR AVERAGE OF ANNUAL VALUES  
MUST BE LESS THAN OR EQUAL TO 50 μG/M³.

150 μG/M³ 24-HOUR CONCENTRATION, 3-YEAR AVERAGE OF THE 99<sup>th</sup> PERCENTILE  
OF THE MONITORED CONCENTRATIONS AT THE HIGHEST MONITOR  
IN AN AREA MUST BE LESS THAN OR EQUAL TO 150 μG/M³.

SECONDARY: SAME AS PRIMARY.

# LEAD MONTHLY MEAN



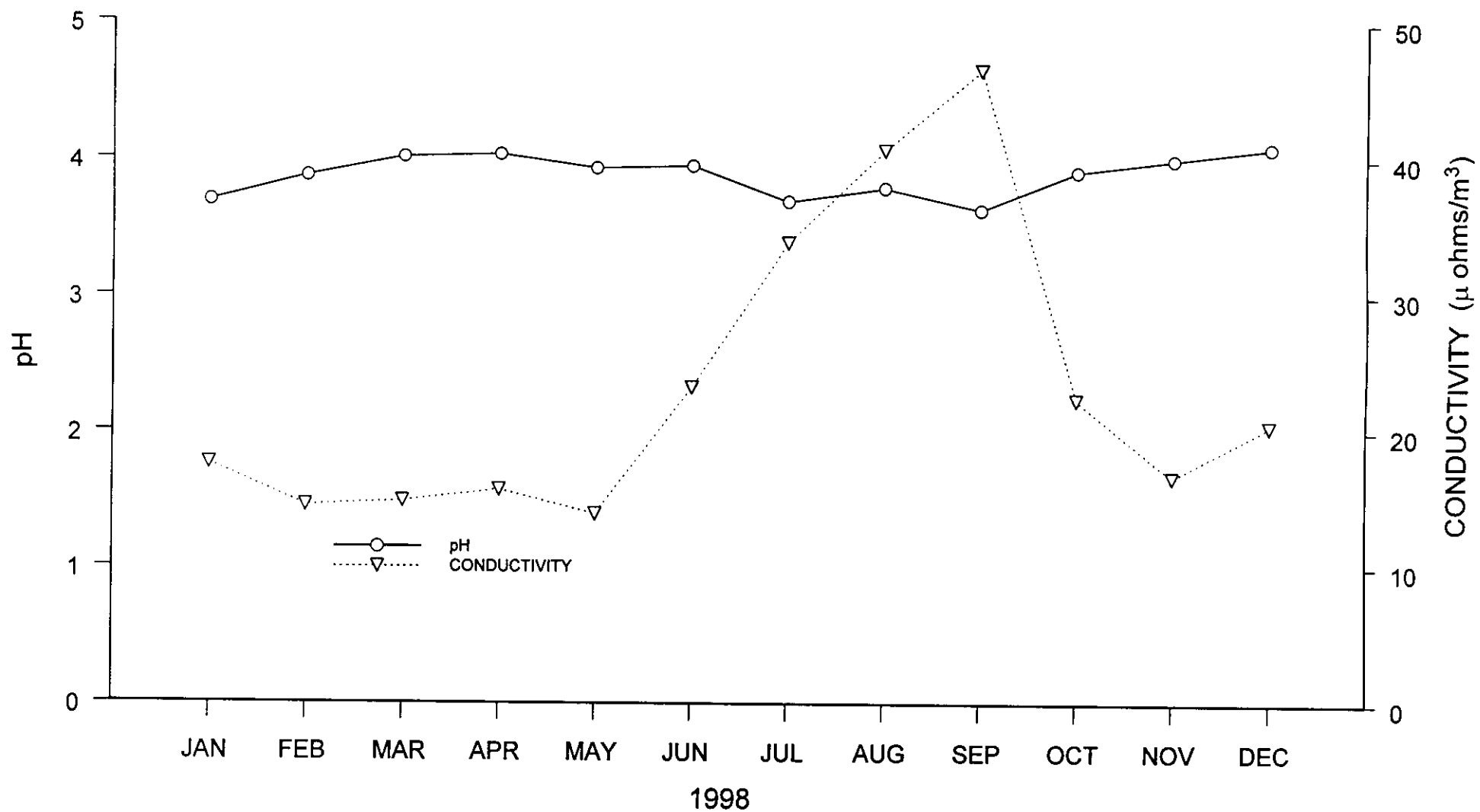
FEDERAL, STATE, AND COUNTY STANDARDS:

PRIMARY: 1.5 μG/M<sup>3</sup> MAXIMUM ARITHMETIC MEAN

PER CALENDAR QUARTER.

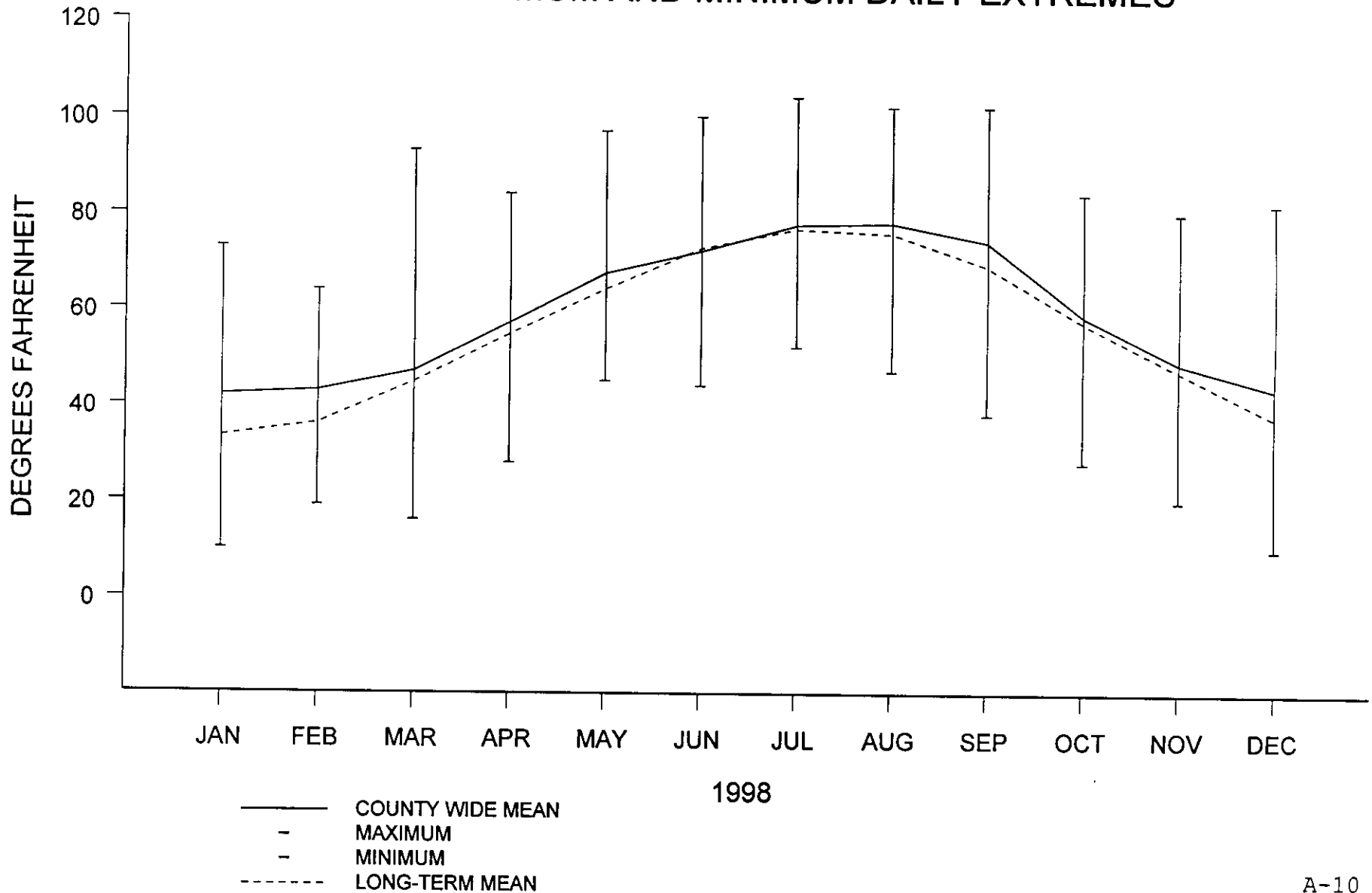
SECONDARY: SAME AS PRIMARY.

## ACID DEPOSITION OCCOQUAN HILL



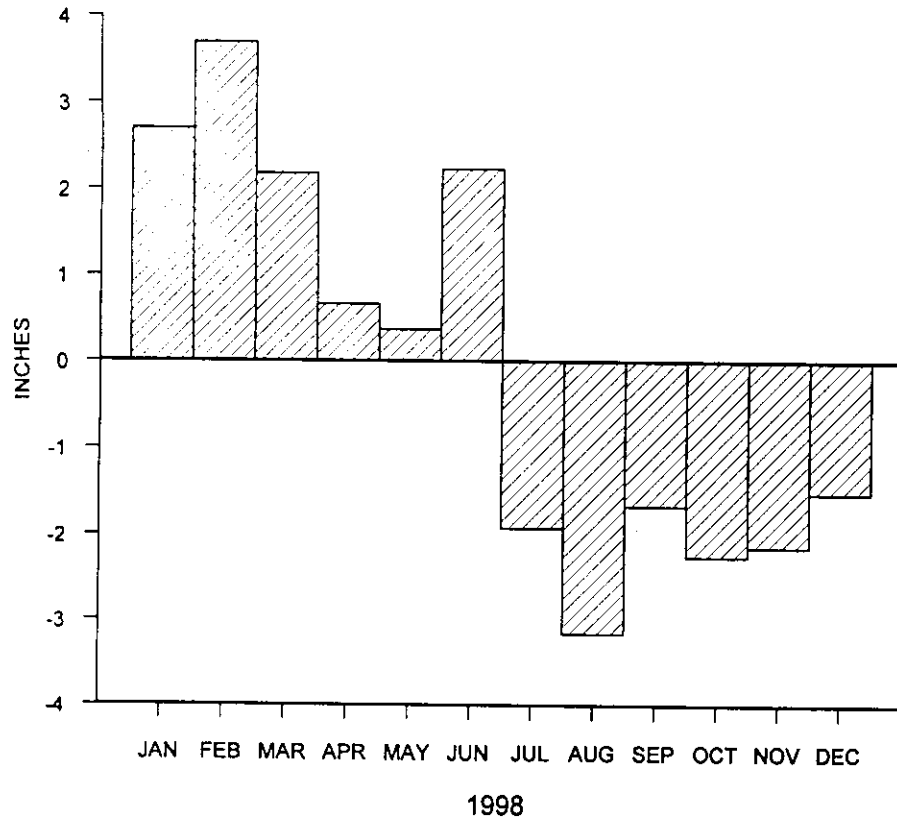
ph and Conductivity monthly values are volume weighted averages.

# MONTHLY MEAN TEMPERATURE WITH MAXIMUM AND MINIMUM DAILY EXTREMES

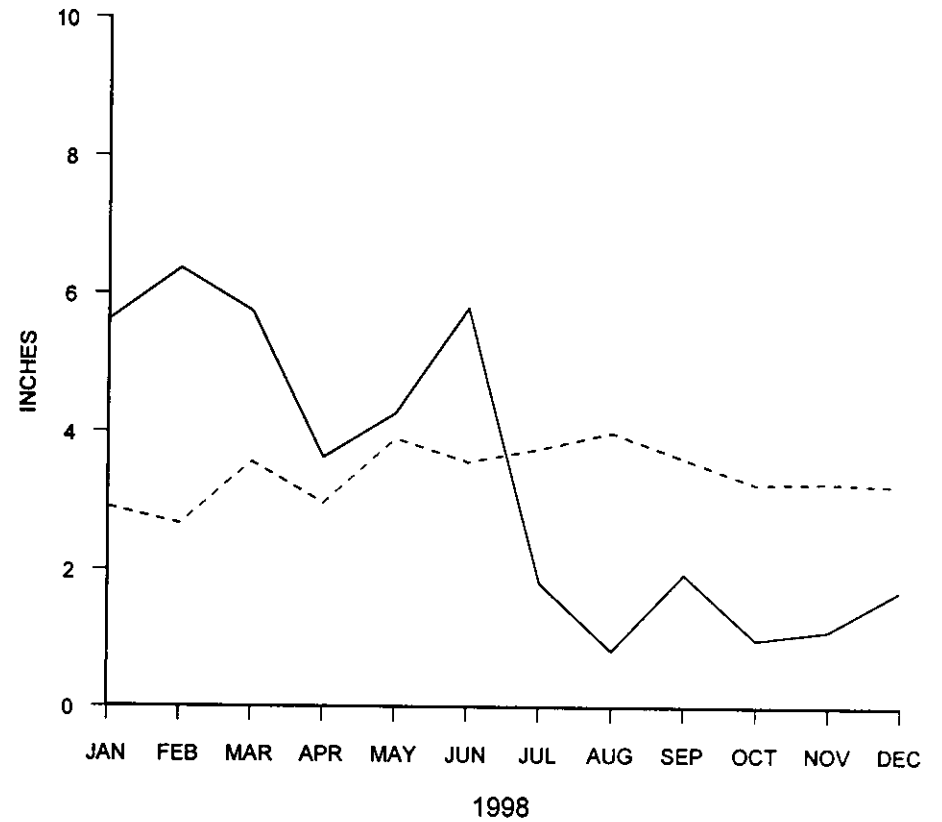


# RAINFALL

## DEPARTURE



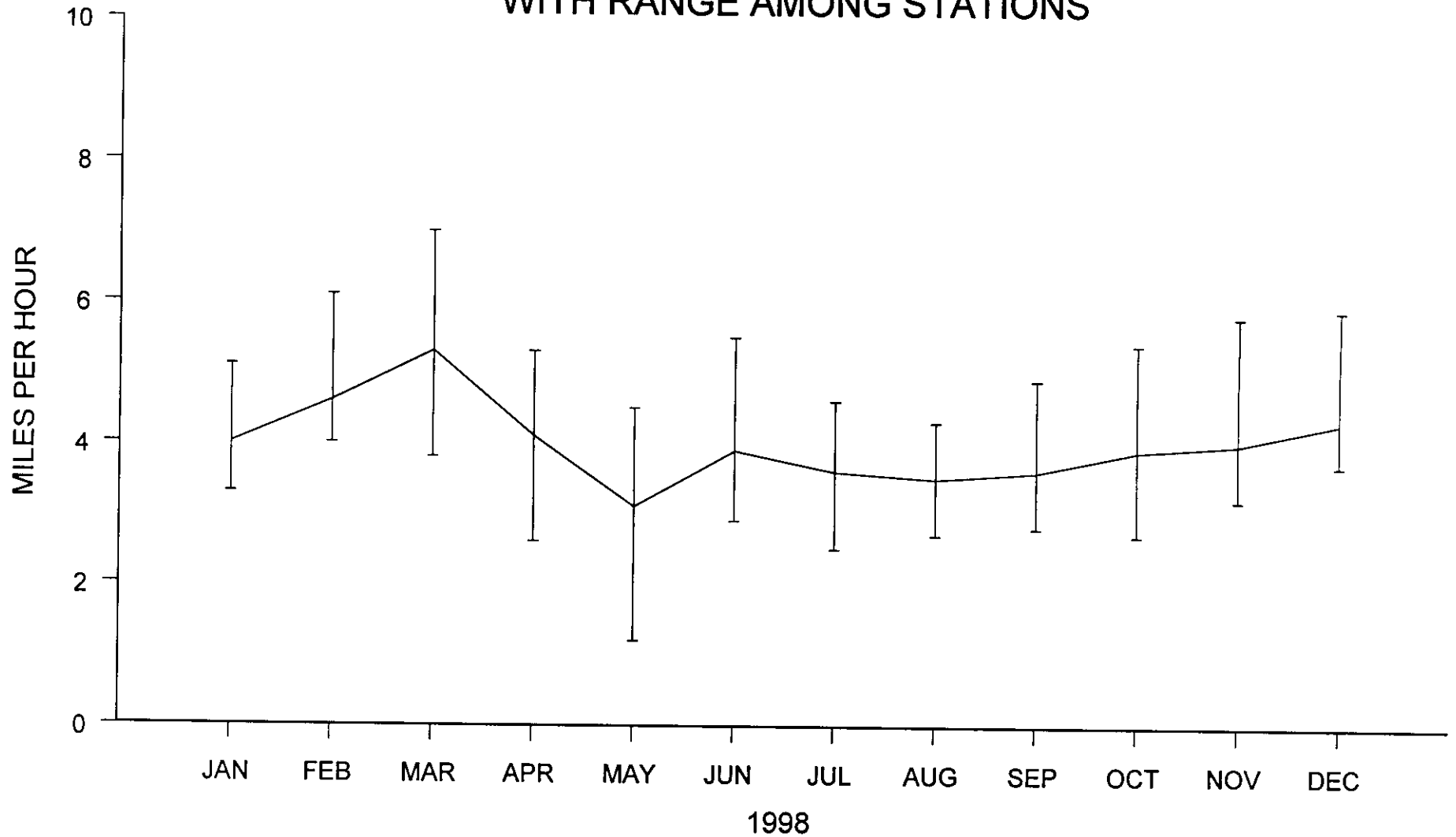
## DEPTH



DEPARTURE: THE DIFFERENCE BETWEEN THE LONG TERM 3 AIRPORT AVERAGE AND THE AVERAGE OF THE OBSERVED AMOUNTS AT ALL STATIONS.

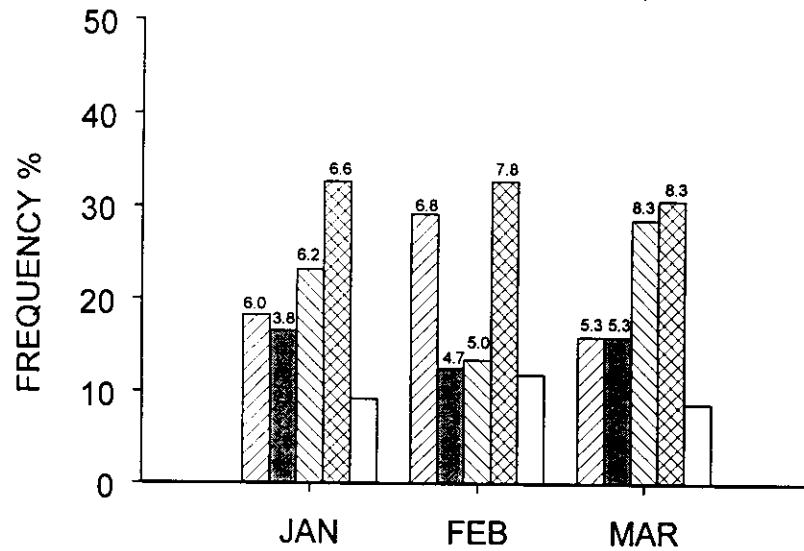
— MONTHLY MEAN  
- - - LONG TERM AVERAGE

# COUNTY MONTHLY MEAN WIND SPEED WITH RANGE AMONG STATIONS

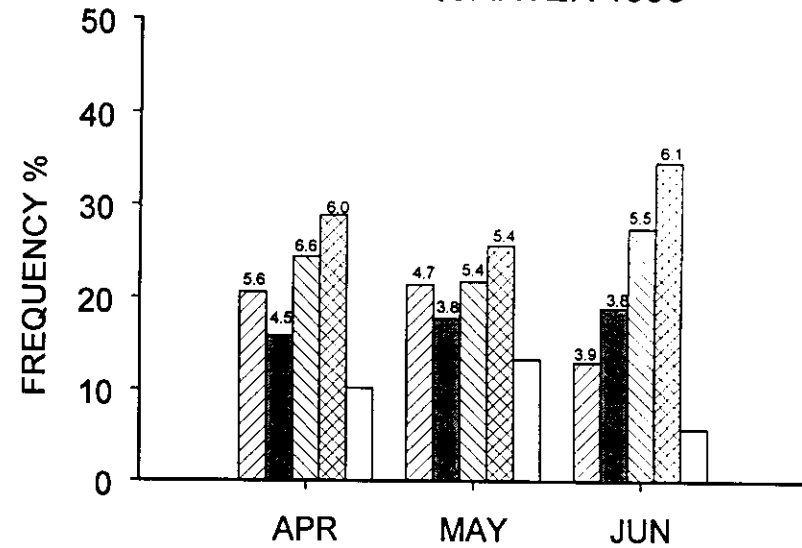


# WIND SPEED AND DIRECTION

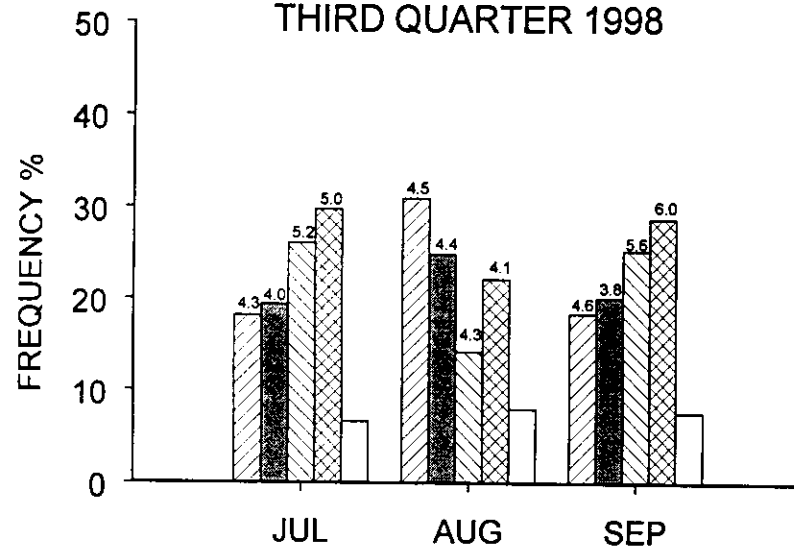
## FIRST QUARTER 1998



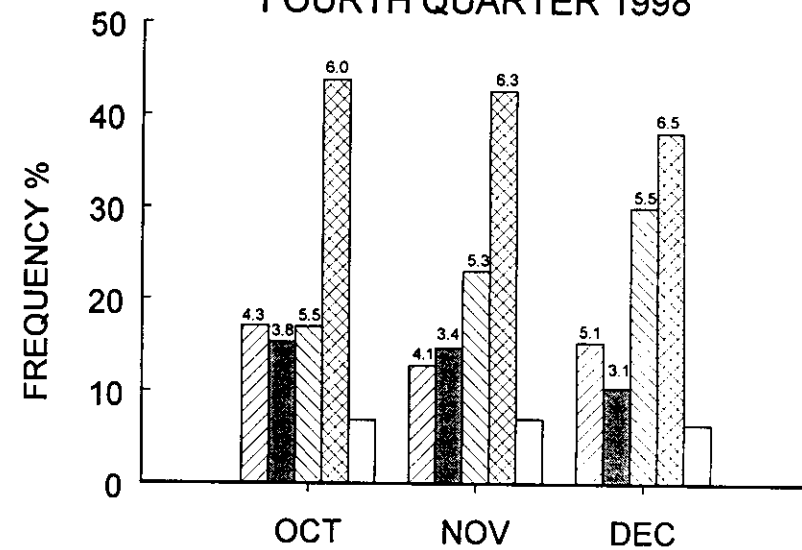
## SECOND QUARTER 1998



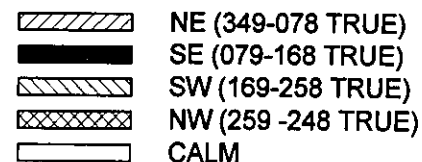
## THIRD QUARTER 1998



## FOURTH QUARTER 1998



MONTHLY AVERAGE WIND SPEED FOR EACH QUADRANT  
APPEARS ABOVE ITS RESPECTIVE BAR.





## **APPENDIX B**

### **ANNUAL TREND ANALYSIS AND GRAPHS**

In this Section, monitoring data for a number of pollutants are aggregated on an annual basis and plotted against time to indicate long-term trends. A trend is a broad long-term movement in the time sequence of air quality measurements.

Comparable data on several factors known to influence air quality are also plotted for ease of comparison. Some caution in making comparisons is urged however, because the nature and strength of the causal relationships, if any, are somewhat speculative.

#### **B1. PARTICULATE MATTER (PM<sub>10</sub>)**

Particulate matter (PM<sub>10</sub>) is emitted directly by mobile and industrial sources or is formed in the atmosphere by reaction with sulfur dioxide, nitrogen oxides, and volatile organic compounds.

In the Group A graphs the composite average annual arithmetic mean PM<sub>10</sub> concentrations are compared with traffic, building activity and rainfall deficit. The building activity graph reflects residential projects under construction during January of each year, and is used as an indicator of development activity for the succeeding year. There has been a long-term downward trend in the PM<sub>10</sub> composite average (-47.8%) since 1986. The 1-year change between 1997 and 1998 was -2.2 percent.

Traffic levels and building activity have the effect of increasing the amount of dust in the air. Pollution emissions from automobiles are declining despite increases in vehicle miles traveled each year. Building activity declined 78.6 percent between 1986 and 1991, and as increased 67.6 percent from 1991 to 1998. PM<sub>10</sub> levels continued to fall between 1991 and 1998 (25.5%) despite an increase building activity. PM<sub>10</sub> trends are highly associated with the trends in sulfur dioxide and nitrogen oxides. PM<sub>10</sub> levels seem to be affected more by reductions in sulfur dioxide, nitrogen oxides, and volatile organic compound emissions than by increases in building activity and traffic levels. Rainfall has the effect of minimizing dust re-entrainment and also cleans dust out of the air. PM<sub>10</sub> levels, on an annual basis, seem to be unaffected by the amount of rainfall in a given year.

## B2. OZONE

Ozone levels tend to be high during the warm months of the year. The official "Ozone Season" for the Metropolitan Washington area begins in April and continues through October of each year. In top left graph of Group B-1, ozone levels are expressed in terms of the composite average (four sites) of the second highest daily maximum 1-hour concentration. The composite average tends to vary from year to year due to a number of different factors affecting ozone levels, such as changing meteorological conditions and precursor emission changes.

The long-term mean of the composite average is 0.13 ppm. In 1983 Fairfax County exceeded the standard (0.12 ppm) on 25 days, in 1987 on 15 days, and in 1988 on 22 days. The composite average in 1983 was 15 percent above its long-term mean, in 1987 it was 8 percent above its long-term mean, and in 1988 it was 22 percent above its long-term mean. There were many hot clear days during the ozone seasons of 1983, 1987, and 1988, conditions very conducive to ozone formation.

In 1992, 1996, and 1997 the composite average was 18, 18.5, and 19.2 percent below its long-term mean. Cooler than normal temperatures persisted during most of these three ozone seasons, as well as above normal cloud cover. These cool and/or cloudy conditions are not conducive to ozone formation. Ozone levels during the 1996 and 1997 ozone seasons were the lowest measured since 1974 when monitoring began. Ozone levels during the 1998 ozone season were higher than the past two years. The composite average (0.120 ppm) increased 13.2 percent above the 1996 and 1997 levels, and was 7.7 percent below the long-term mean. There has been a downward trend in the composite average, -11.1 percent, since 1979.

The top right graph in Group B-1 depicts the number of "unhealthful" days as defined by the Pollutant Standards Index (PSI). The PSI is the national uniform index system, the use of which in this area is required by Federal regulation. For purposes of this report, an "unhealthful" day is defined as any day when the measurement at any Fairfax County station yields an index value greater than 100. In 1983 Fairfax County experienced 30 "unhealthful" days, in 1987 17 "unhealthful" days, and in 1988 28 "unhealthful" days. The large number of "unhealthful" days during these 3 years was due primarily to the occurrence of meteorological conditions very conducive to ozone formation. There were 5 "unhealthful" days in 1998.

The bottom left graph is a plot of the composite average of the average number of exceedant days (an exceedant day is one during which a site had at least one hourly average greater than the ozone standard). The average number of exceedant days is a 3-year running average and is calculated by dividing the total number of exceedant days in a given year plus those in the two prior years by three. The plotted values are a composite of the average number of exceedant days averaged over all the County ozone sites. In 1988 and 1989 the composite average was 7.0 days, the highest value recorded, and reflects the influence of the high number of exceedant days in 1988 on the 3-year averages. The composite averages in 1997 and 1998, 0.58, are the lowest observed. This is an indication that we are very close to attaining the 1-hour ozone standard.

On July 18, 1997 EPA promulgated new national ambient air quality standards (NAAQS) for ozone. EPA changed the averaging time to 8 hours and changed the form of the standard from an expected exceedance form to a concentration-based form. The NAAQS for ozone are met at an ambient monitoring site when the 3-year average of the annual fourth highest daily maximum 8-hour concentration is less than or equal to 0.08 ppm. The new standards became effective on September 16, 1997, and the 1-hour standard will remain in effect until EPA determines that this region has attained the 1-hour standard.

The graphs in Group B-2 will be used to track ozone trends associated with the new 8-hour standards. The statistics used in the plots are directly related to the form and averaging time of the new 8-hour standards. Trends in the composite average of the fourth highest daily maximum 8-hour concentration are shown in the top left graph of Group B-2. There is some indication of a slight downward trend in the composite average since 1979, however, the trend is not significant and is probably just the chance variation from year to year in precursor emissions and meteorology. The composite average increased 15 percent between 1997 and 1998. The top right graph is a plot of the composite average of the 3-year mean fourth highest maximum daily 8-hour concentration and is used to track compliance with the new 8-hour standard. There has been a significant downward trend in the composite average, - 11.2 percent, since 1979. The 1998 composite average of the 3-year mean was 0.087 ppm.

The bottom left graph is a plot of the composite average of the number of days with maximum 8-hour concentration above the 8-hour standard. It shows the year to year variability in the number days the ozone standard was exceeded. The composite average increased in 1998 to 14 days. The bottom right graph is a plot of the number of days above the 8-hour standard by month using all ozone data from 1974 to 1998. April is the earliest month in which the 1-hour standard has been exceeded, while ozone concentrations above the 8-hour standard have been observed in March. July has the greatest number of days above the 8-hour standard. There have been no exceedances of either the 1-hour standard or the 8-hour standard in October.

The graphs in Group B-3 are plots of the maximum daily 8-hour ozone concentration at each ozone monitoring site during the 1998 ozone season. They show the day to day variation in the maximum daily 8-hour mean and the number of exceedances of the 8-hour standard at each site. Mount Vernon and Seven Corners exceeded the 8-hour standard on 17 days, Cub Run on 16 days, and Lewinsville on 7 days.

Ozone in Fairfax County has improved since 1979. Citizens in the County are exposed to fewer unhealthful ozone days and generally lower ozone concentrations on those days.

### **B3. INDUSTRIAL AND SPACE HEATING EMISSIONS**

Sulfur dioxide and nitrogen dioxide trends are shown in Group C along with trends in existing dwelling units and heating degree-days. These pollutants are produced by fossil fueled space heating and electrical utility boilers as well as by internal combustion engines. In the top left graph the sulfur dioxide levels are expressed in terms of the composite annual average concentration. The composite average decreased 8.8 percent between 1986 and 1998. The sulfur dioxide composite average has shown a long-term downward trend, - 33 percent, since 1979.

In the top right graph the nitrogen dioxide levels are expressed in terms of the composite annual average concentration. The composite average increased 3.1 percent between 1997 and 1998. The nitrogen dioxide composite average has shown a long-term downward trend, - 24.6 percent, since 1979.

The bottom left graph is a plot of the number of dwelling units in Fairfax County. The growth rate in the housing inventory averaged 4.1 percent between 1985 and 1990. The growth rate has slowed to 1.7 percent per year since 1991.

The bottom right graph is a plot of heating demand. Geographical differences in heating demand are substantial, with approximately 730 degree-days average difference between the highest and lowest county stations. Both the age of a community (fossil or electric fuel) and its location (high or low heating demand) influence its emission response to changes in overall heating demand.

### **B4. AUTOMOTIVE EMISSIONS**

Carbon monoxide and nitrogen oxides are produced principally by automotive sources and secondarily by fossil fuel space heating. At one time, the primary source of lead in ambient air in this area was the combustion of leaded fuels by automotive vehicles. Group D shows trends of these pollutants along with the traffic trends.

In the top left graph the carbon monoxide levels are expressed in terms of the composite average of the second highest 8-hour average concentration. There has been a long-term downward trend, - 79.3 percent, in the composite average since 1974. Carbon monoxide levels tend to be high during the colder months of the year, January, February, November, and December. High 8-hour average concentrations frequently occur in the 5pm - 1am and 6pm - 2am time frames, and are associated with emission generated by evening rush hour traffic and strong winter temperature inversions. Fairfax County has never exceeded the 1-hour standard and has not violated (2 exceedances in one year) the 8-hour standard since 1979. The last exceedance of the 8-hour standard was in 1986. Fairfax County is in attainment for the NAAQS for carbon monoxide.

In the top right graph lead levels are expressed in terms of the composite average of the maximum quarterly average concentration. There has been a long-term decrease of 96 percent in lead levels since 1981. The 1997 composite average is 1 percent of the National Standard of  $1.5 \mu\text{g}/\text{M}^3$ . This decrease in the composite average can be attributed to the Environmental Protection Agency's (EPA) program of eliminating lead in gasoline. The EPA lowered the allowable lead content in gasoline by 50 percent on July 1, 1985. A further reduction to 0.1 grams/gal, a 90% reduction from pre-July 1985 levels, was implemented on January 1, 1986. In 1975 unleaded gasoline was introduced, which now accounts for about 99% of gasoline sales.

In the bottom left graph oxides of nitrogen levels are expressed in terms of the composite average of the annual average concentration. The annual average is calculated as the sum of the annual averages of nitrogen dioxide and nitrogen oxide. There has been a downward trend in the composite average, - 39.9 percent, since 1978.

In the bottom right graph the number of Vehicle miles traveled in the County each year is plotted. Despite increases in the number of Vehicle miles traveled pollutant emissions from motor vehicles have continued to decline. Additional emission control strategies will be needed in the future if declines in motor vehicle emissions are offset by continued growth in the number of vehicle miles traveled.

## **B5. ACID DEPOSITION**

Sulfuric and nitric acids are the two major components of both wet and dry acidic deposition. The top left and top right graphs in Group E show trends in their precursors, sulfur dioxide and nitric oxides. Sulfur dioxide reacts with hydroxyl radicals, hydrogen peroxide and ozone, to produce sulfate ions. Nitric oxide reacts with a number of different pollutants such as hydrocarbons, carbon monoxide, hydroperoxyl radicals, hydroxyl radicals, and ozone to produce nitric acid, particulate nitrate, and peroxyacetyl nitrate (PAN). The bottom left and bottom right graphs show trends in rainfall and volume weighted pH at the Occoquan Hill site. There is no evidence for a trend in pH at Occoquan Hill; the long-term average is 4.2.

## B6. WEATHER

Meteorological monitoring was initiated in 1974 for wind direction and wind speed, temperature, and rainfall. Group F shows trends of rainfall, temperature, heating demand, and cooling demand.

The top left graph illustrates the year to year variability inherent in rainfall. The values used in this graph are obtained as follows: the observed rainfall amounts at all county stations, plus Dulles, National, and Davison airports for each month and for each year are averaged to obtain a composite county average amount, for the year of interest. The long-term average uses the climatological values from the three airports. Annual rainfall in 1998 was 39.81 inches, 0.87 inches below normal. Annual rainfall in 1996 was 55.82 inches the wettest year since 1974. The driest year was in 1980, 29.94 inches of rainfall, 10.84 inches below normal.

The top right graph is a plot of the annual mean temperature. The annual mean temperature in 1998 (59.1°F) was the warmest that has been observed in the County. The United States average temperature in 1998 was also one of the warmest years on record. The coolest annual mean temperature observed in the County was in 1978 (53.0°F). There has been an upward trend in the annual mean temperature in the County since monitoring was initiated in 1974. Several factors have probably influenced the apparent trend in the annual mean temperature, improvements in the temperature measurement instrumentation, changes in sample site location, and a "heat island" effect. Fairfax County has become increasingly developed over the last twenty years. There are more buildings and streets, which can collect, heat during the day and hold on to it longer at night, increasing the temperature of the surrounding air.

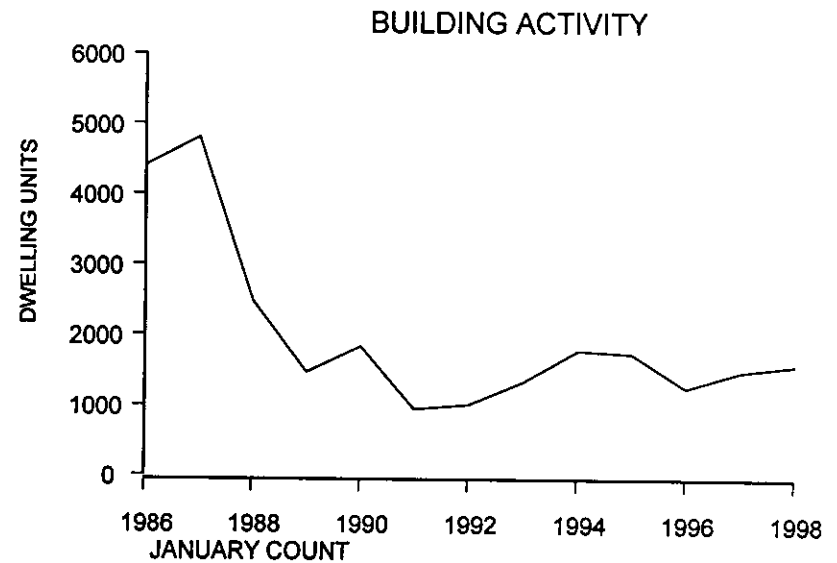
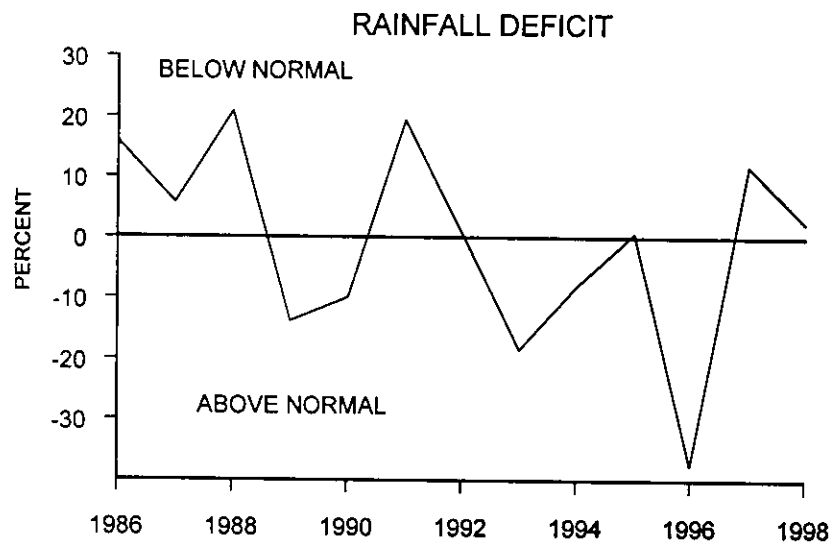
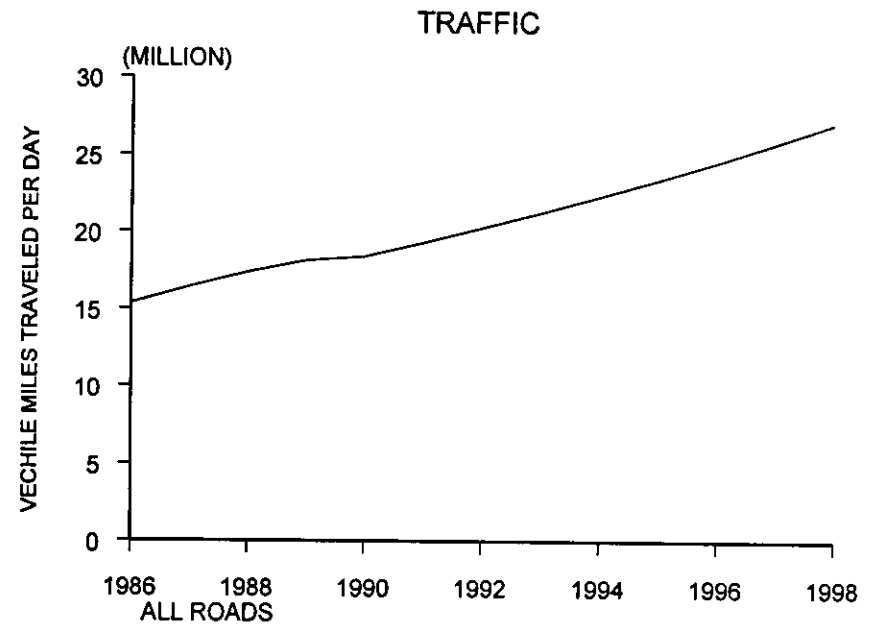
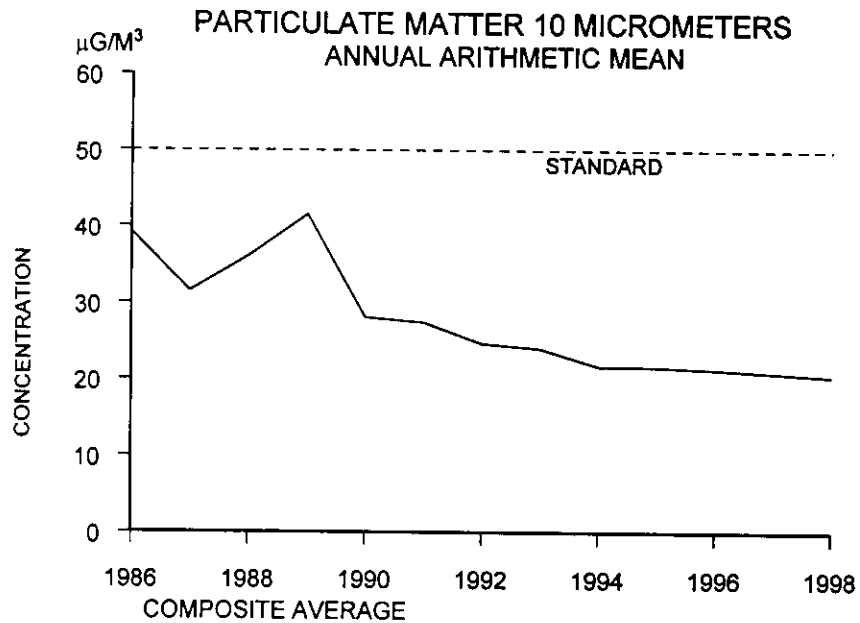
The bottom left graph is a plot of the County average heating demand. Heating degree-days are used as a rough indicator of the heating demand, the amount of fuel consumed in space heating. One heating degree-day is given for each degree the daily mean temperature falls below 65°F. The heating degree-days are totaled over a heating season and averaged over all County monitoring sites. There has been a downward trend in the heating demand since 1978.

The bottom right graph is a plot of the County average cooling demand. Cooling degree-days are used as a rough estimate of the energy requirements for refrigeration and air conditioning. One cooling degree-day is given for each degree the daily mean temperature rises above 65°F. The cooling degree-days are totaled over the cooling season and averaged over all County monitoring sites. There is no evidence for a trend in the cooling demand.

The predominant wind directions in the summer months are from the southwest quadrant. In the winter and late fall the predominant winds are from the northwest quadrant. Higher mean wind speeds are associated with winds from the northwest quadrant.

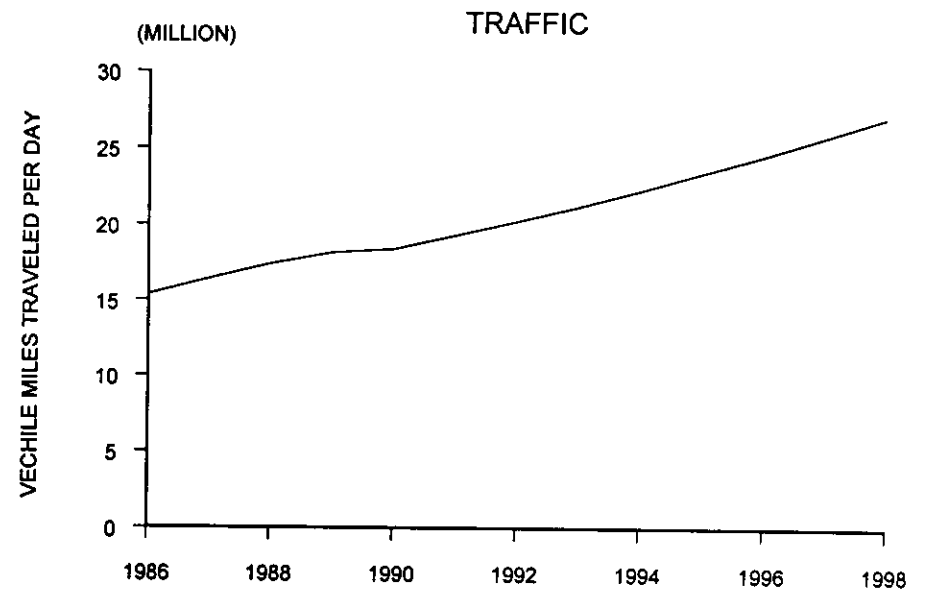
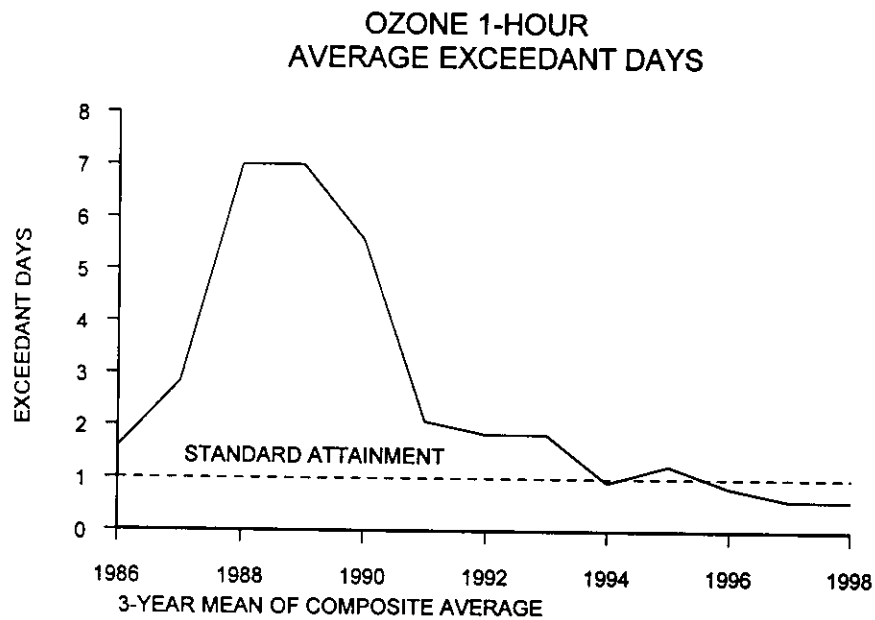
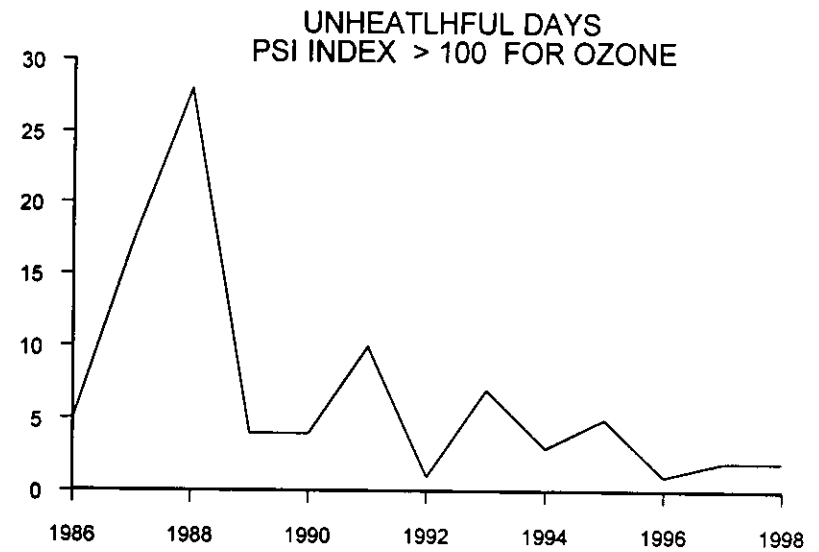
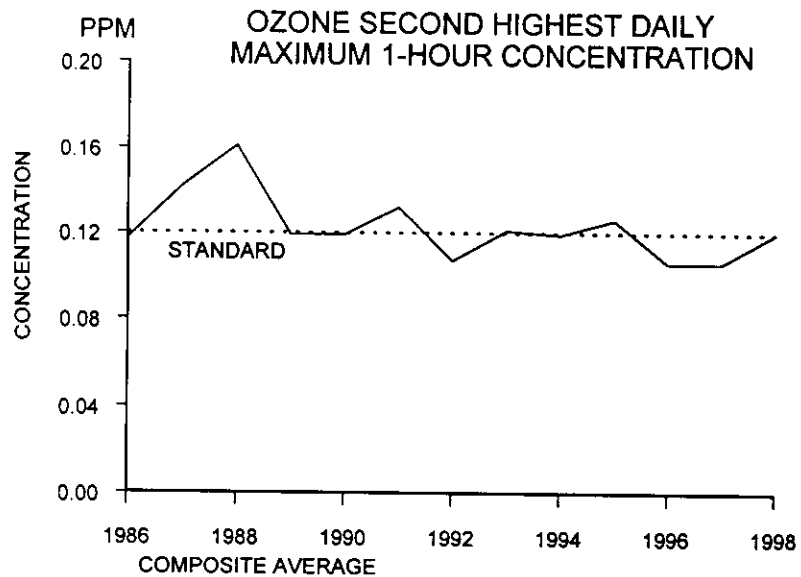
# ANNUAL TRENDS

GROUP A



# ANNUAL TRENDS

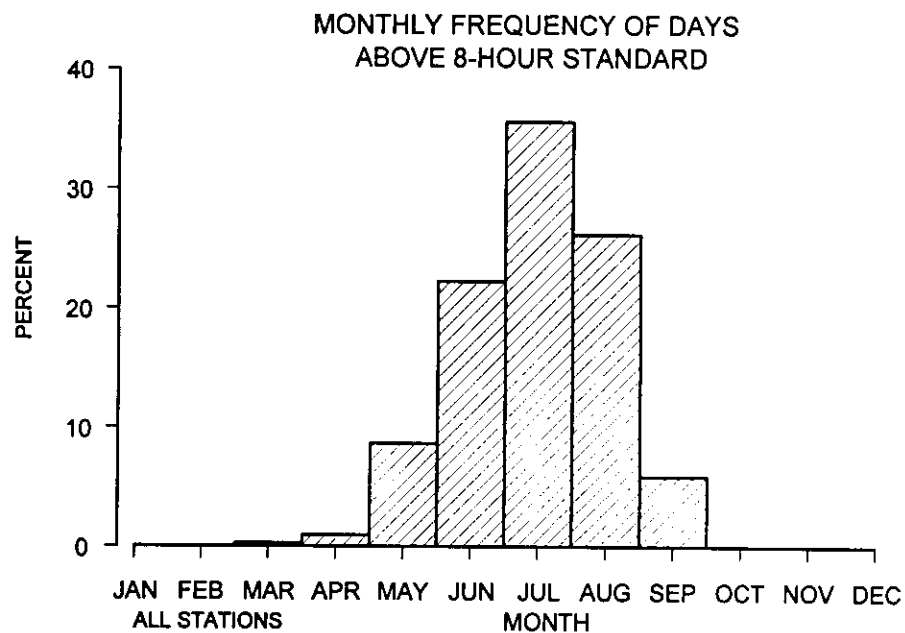
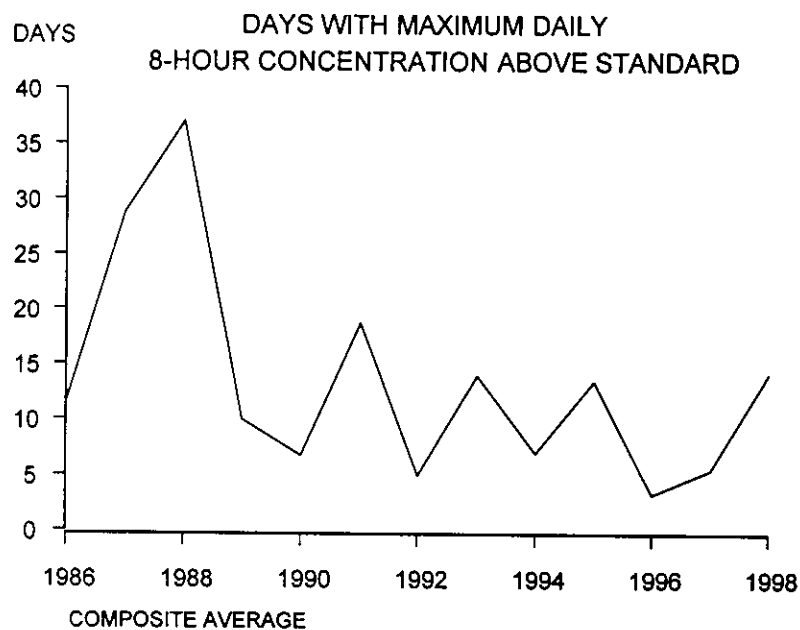
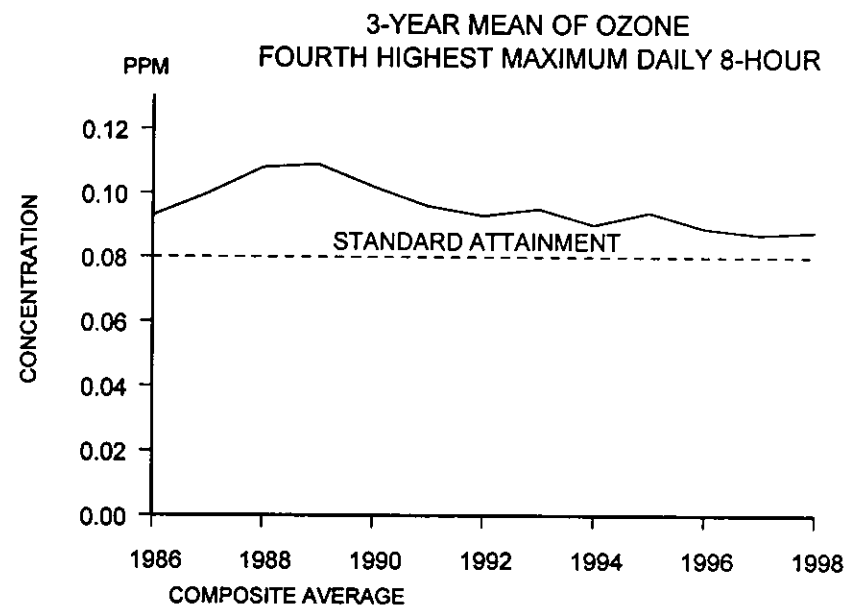
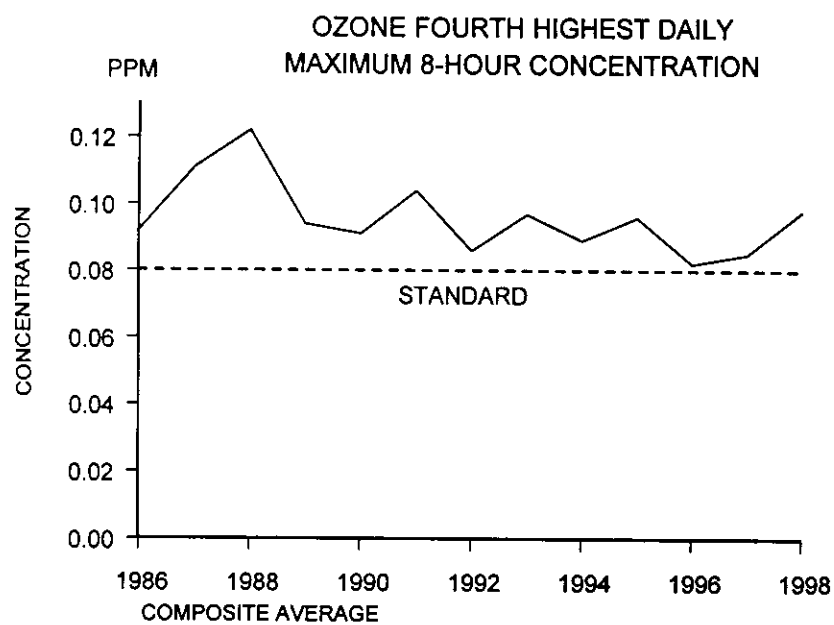
GROUP B-1





# ANNUAL TRENDS

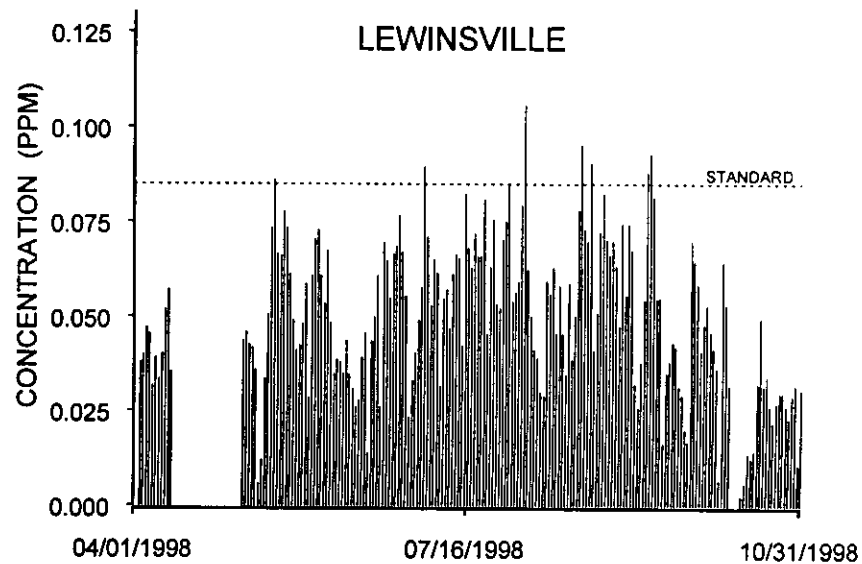
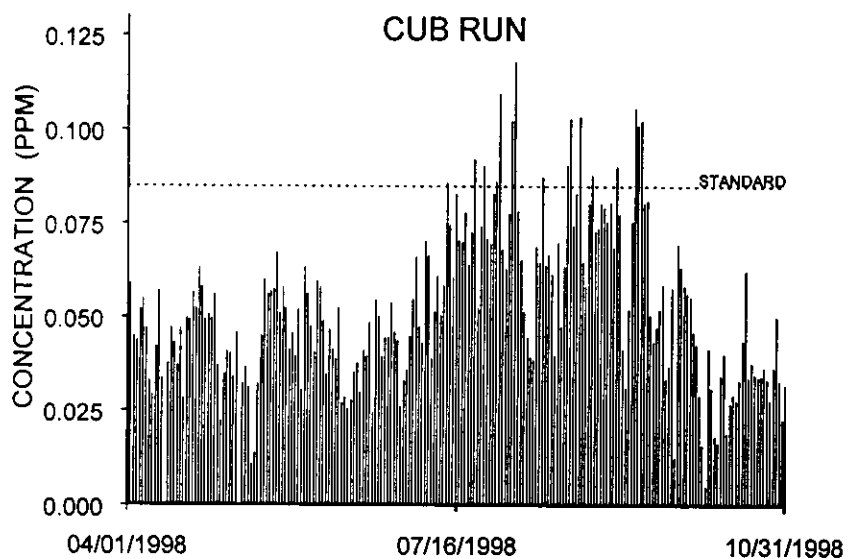
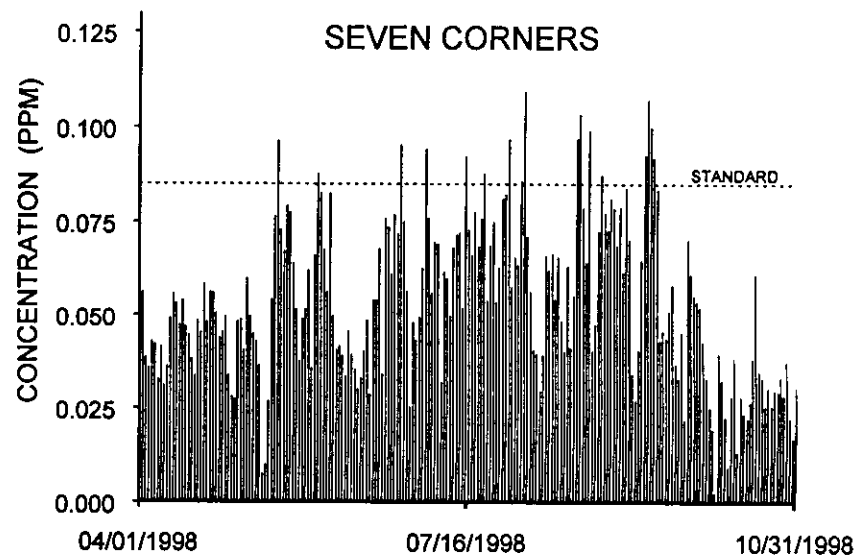
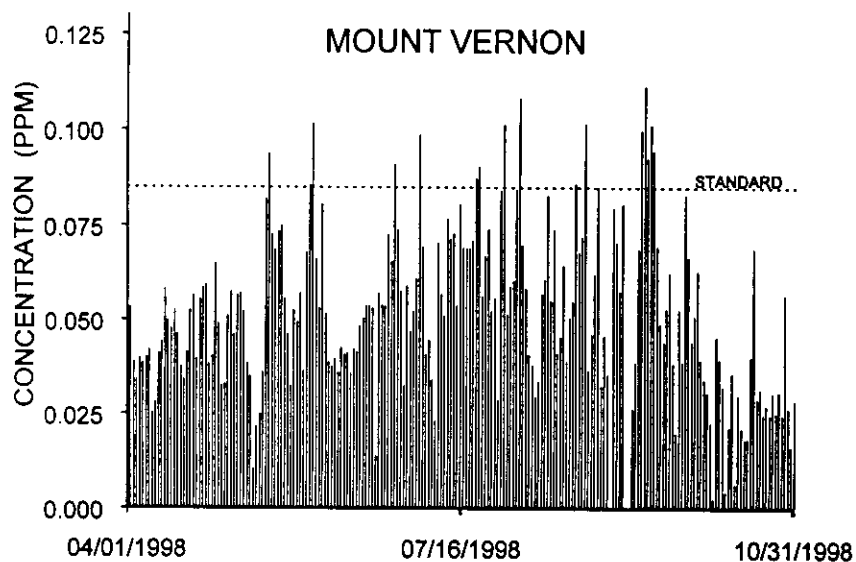
GROUP B-2



# ANNUAL TRENDS

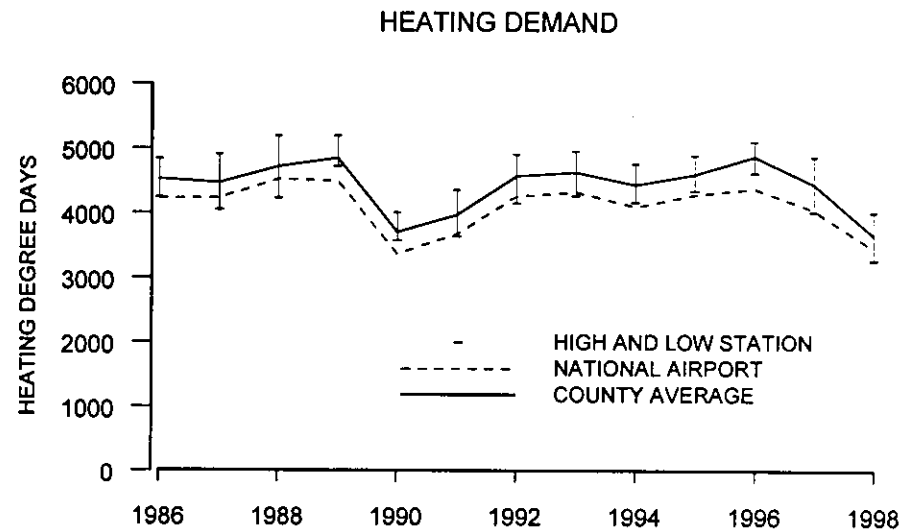
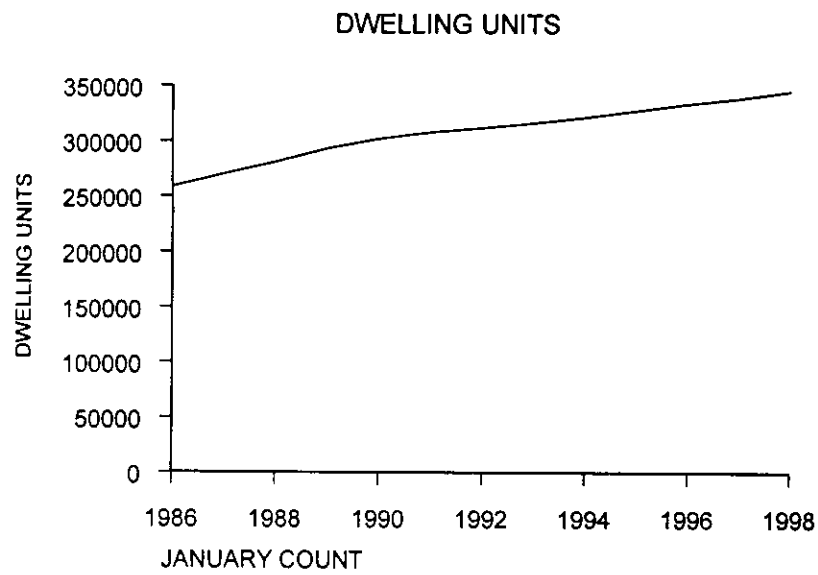
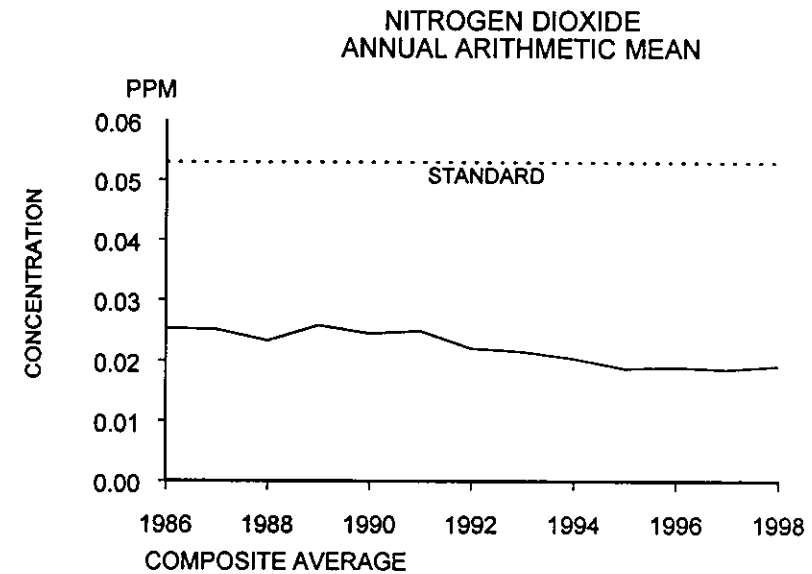
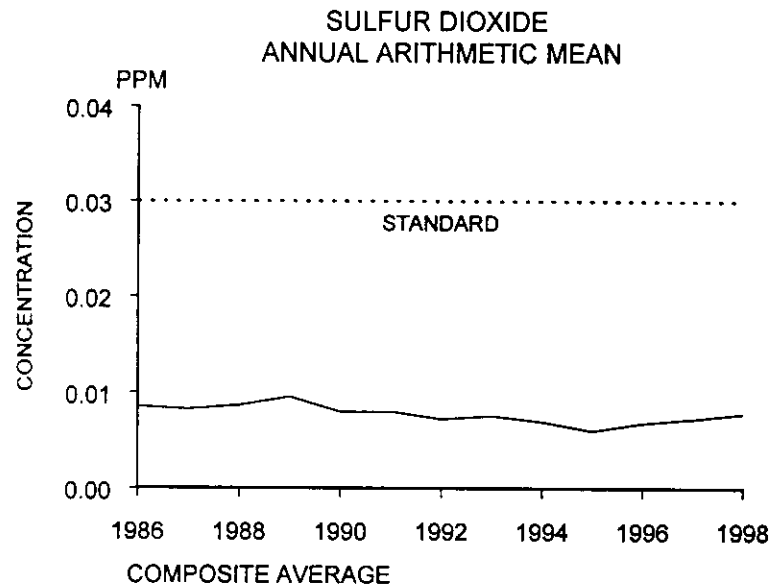
GROUP B-3

## MAXIMUM DAILY 8-HOUR OZONE CONCENTRATION



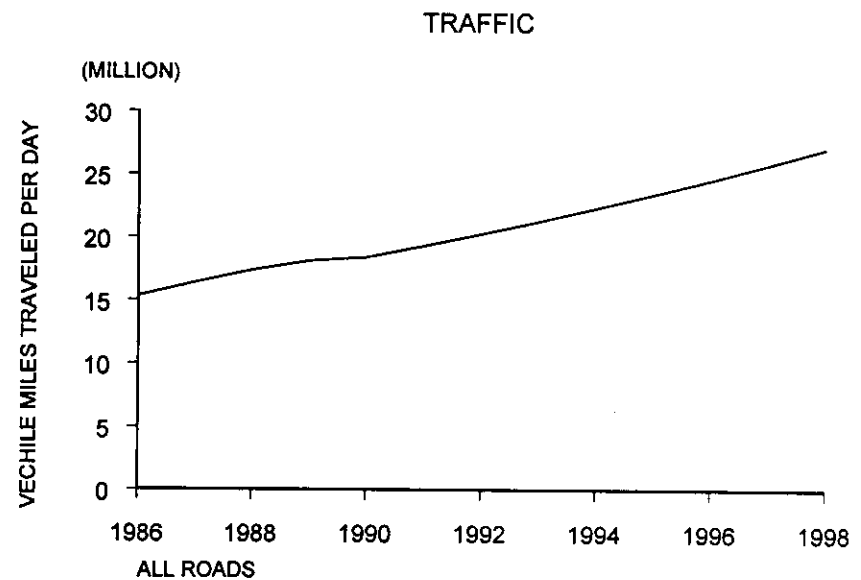
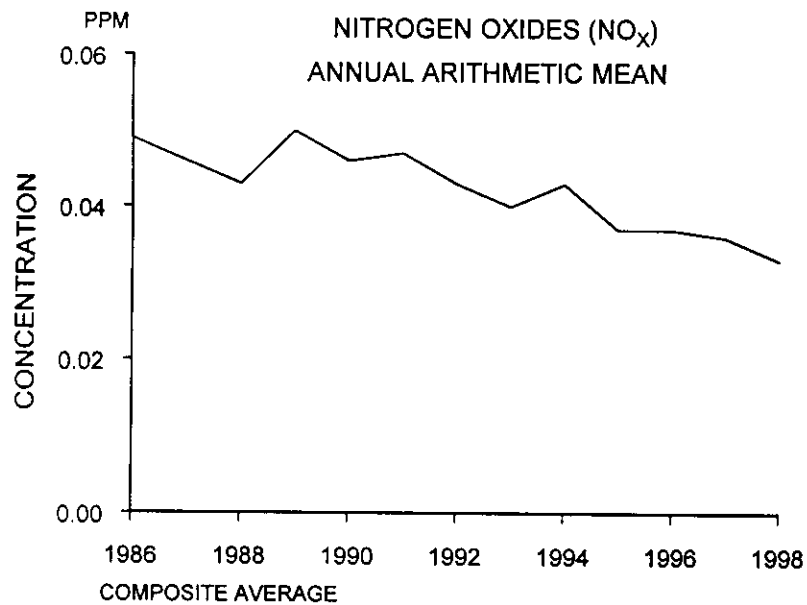
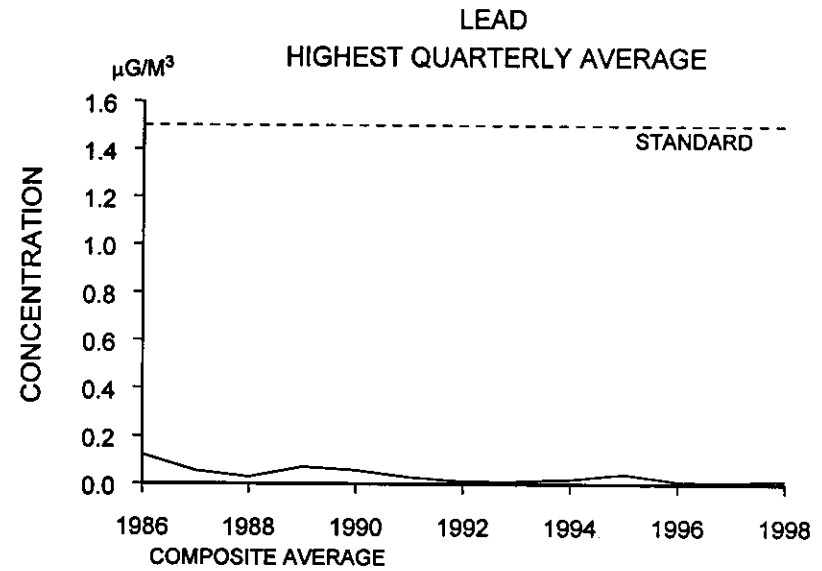
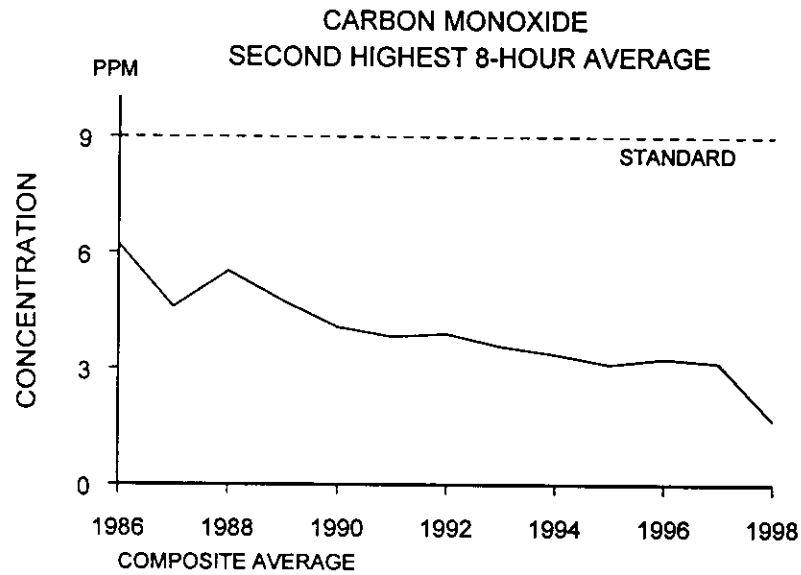
# ANNUAL TRENDS

## GROUP C



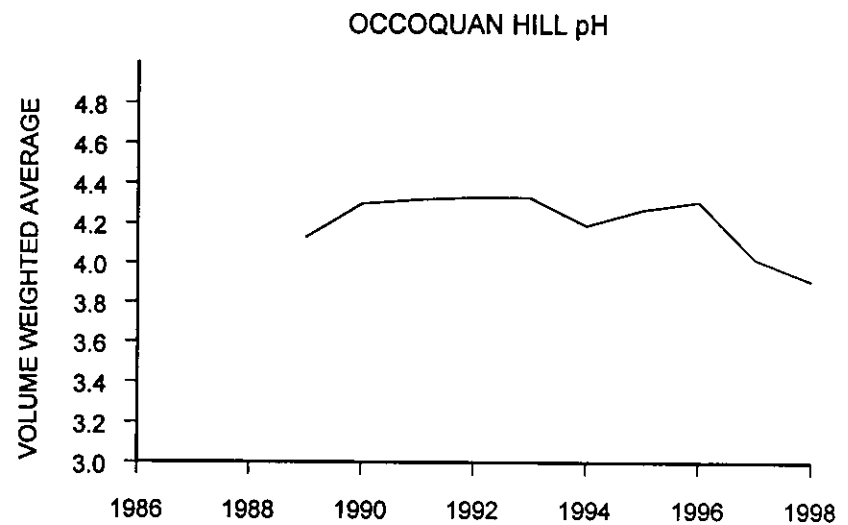
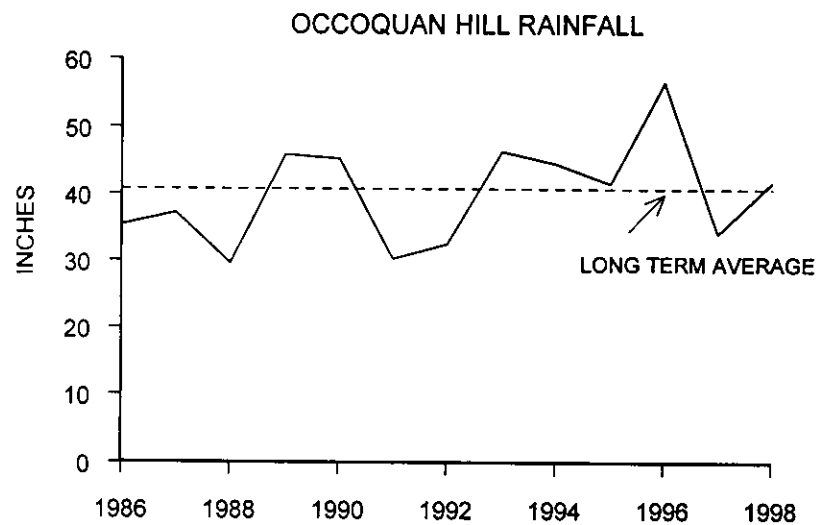
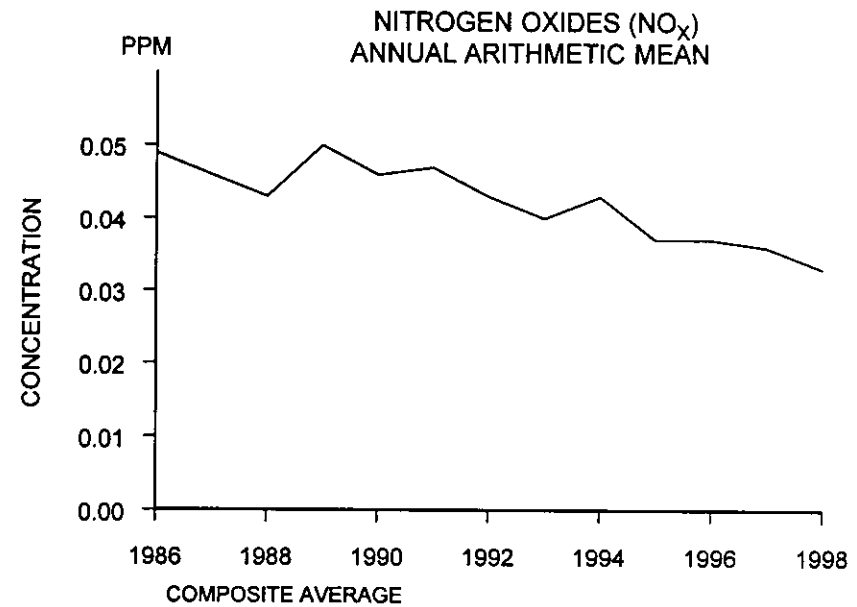
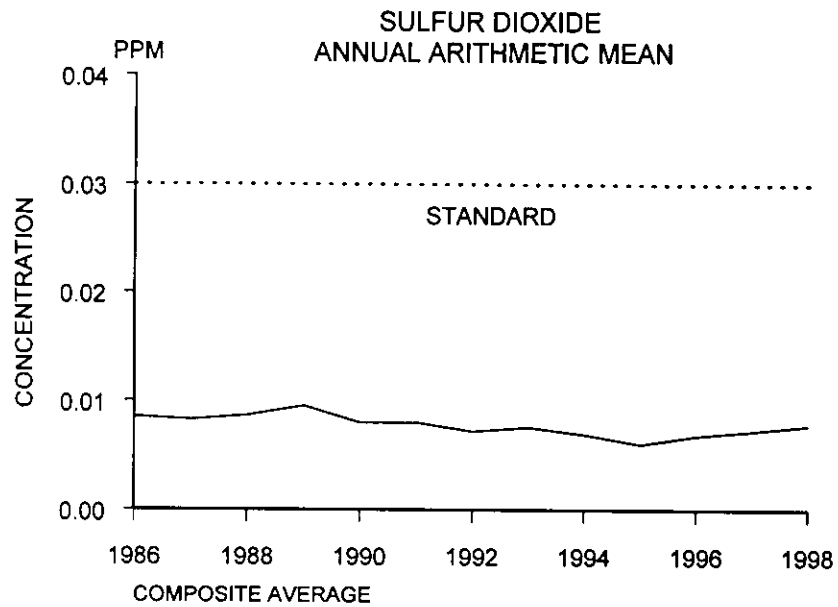
# ANNUAL TRENDS

GROUP D



# ANNUAL TRENDS

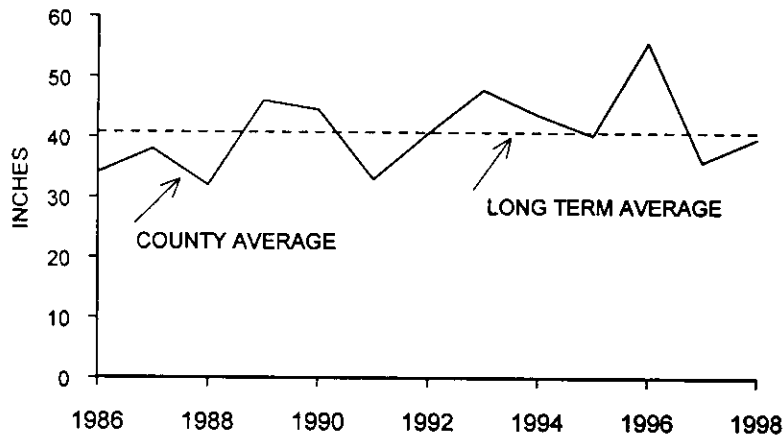
GROUP E



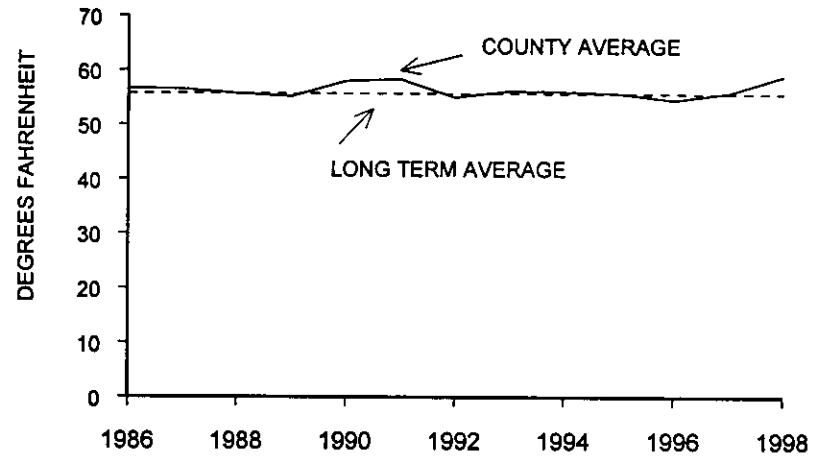
# ANNUAL TRENDS

GROUP F

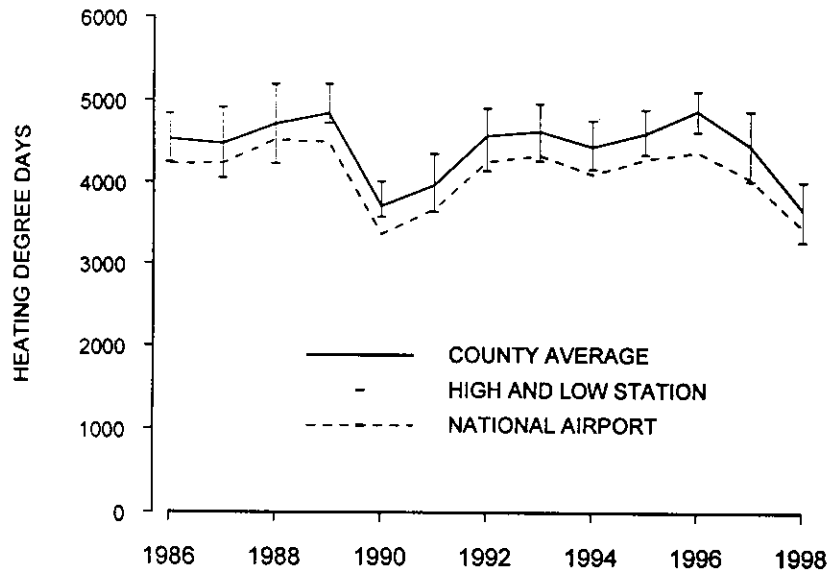
## RAINFALL



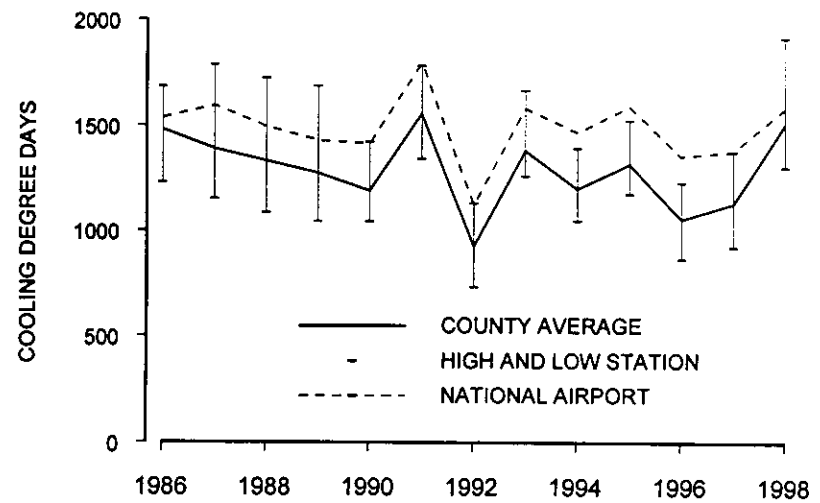
## ANNUAL MEAN TEMPERATURE



## HEATING DEMAND



## COOLING DEMAND



**APPENDIX C**  
**MONITORING SITES AND MAP**

**SEVEN CORNERS** (continuous air monitor #1)

6100 Arlington Blvd., Falls Church

(Montgomery Ward Store)

Latitude 38° 52' 05.4" N

Longitude 77° 08' 34.91" W

UTM Coords. 314.073 km E, 4304.095 km N

Tax Map 51-4

AIRS # 51-059-1004; Va.State # L-46-G

Air Pollutant Parameters: SO<sub>2</sub>; NO/NO<sub>2</sub>; CO; O<sub>3</sub>; PM<sub>10</sub>.

Meteorological parameters: Wind Speed and Direction; Temperature; Precipitation.

**CUB RUN** (continuous air monitor #3)

Upper Cub Run Drive, Chantilly

(Former Upper Cub Run Treatment Plant)

Latitude 38° 53' 38.3" N

Longitude 77° 27' 56.3" W

UTM Coords. 289.177 km E, 4307.697 km N

Tax Map 33-4

AIRS # 51-059-0005; Va.State # L-46-F

Air Pollutant Parameters: SO<sub>2</sub>; NO/NO<sub>2</sub>;

CO; O<sub>3</sub>; PM<sub>10</sub>.

**MOUNT VERNON** (continuous air monitor #2)

2675 Sherwood Hall Lane, Mount Vernon

(Mount Vernon Fire Station #9)

Latitude 38° 44' 32" N

Longitude 77° 04' 37" W

UTM Coords. 319.488 km E, 4290.214 km N

Tax Map 102-1

AIRS # 51-059-0018; Va. State # L-46-B3

Air Pollutant Parameters: SO<sub>2</sub>; NO/NO<sub>2</sub>; CO; O<sub>3</sub>; PM<sub>10</sub>;

Meteorological parameters: Wind Speed and Direction; Temperature; Precipitation.

**LEWINSVILLE** (continuous air monitor #4)

1437 Balls Hill Road, McLean

(McLean Government Center)

Latitude 38° 55' 56.6" N

Longitude 77° 11' 54.6" W

UTM Coords. 309.443 km E, 4311.600 km N

Tax Map 30-1

AIRS # 51-059-5001; Va. State # L-46-A8

Air Pollutant Parameters: SO<sub>2</sub>; NO/NO<sub>2</sub>;

CO; O<sub>3</sub>; PM<sub>10</sub>.

Meteorological parameters: Wind Speed and Direction; Temperature; Precipitation.



**OCCOQUAN HILL**

9900 Ox Road, Lorton  
(Fairfax County Water Authority)  
Latitude 38° 41' 23.8" N  
Longitude 77° 15' 34.7" W  
UTM Coords. 303.475 km E, 4284.648 km N  
Tax Map 112-2  
AIRS # 51-059-0023  
Meteorological Parameters: Wind Speed and Direction;  
Temperature; Precipitation.

**SPRINGFIELD**

6120 Brandon Ave. Springfield  
(Doctor's Exchange)  
Latitude 38° 47' 00.3" N  
Longitude 77° 10' 57.0" W  
UTM Coords. 310.420 km E, 4294.805 km N  
Tax Map 80-4  
AIRS # 51-059-3002; Va. State # L-46-Z  
Air Pollutant Parameters: TSP; PM<sub>10</sub>; Lead.

**GUNSTON**

10100 Gunston Road, Lorton  
(Gunston Elementary School)  
Latitude 38° 41' 03" N  
Longitude 77° 12' 35" W  
UTM Coords. 307.369 km E, 4283.938 km N  
Tax Map 113.2  
AIRS # 51-059-0021; Va. State # L-46-B5  
Air Pollutant Parameters: TSP.

**I-95**

9850 Furnace Road, Lorton  
(Fairfax County Landfill Service Road)  
Latitude 38° 41' 30.5" N  
Longitude 77° 14' 41.5" W  
UTM Coords. 305.280 km E, 4284.740 km N  
Tax Map 113-1  
AIRS # 51-059-0031  
Air Pollutant Parameters: Lead.

**LUCK**

15500 Lee Hwy., Centreville,  
Latitude 38° 49' 16.0" N  
Longitude 77° 27' 05.5" W  
UTM Coords. 284.310 km E, 4300.512 km W  
Tax Map 64-1  
AIRS # 51-059-0024  
Meteorological Parameters: Wind Speed and Direction;  
Temperature; Precipitation.

**FRANCONIA**

Robert E. Lee Recreation Center  
6601 Telegraph Road, Franconia  
UTM Coords. 317.090 km E, 4293.450 km N  
Tax Map 92-1  
AIRS # 51-059-0030; Va. State # L-46-B9  
Air Pollutant Parameters; Ozone.

# AIR QUALITY & METEOROLOGICAL MONITORING SITES

C-4

